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STATE SUPPLY BULLETIN



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The price of natural rubber continues to rule around Rs. 975 Union Ministry of Commerce to import an additional consignment of 15,000 tonnes. In the international market top quality rubber (RMA-1) costs only Rs. 90) per quintal while it is only Rs. 800 for 10 indicative of a decliming trend. The price of imported rubber would be between Rs. 900 and Rs. 990 depending on grade. It is well packed, graded and cess free too, while indigenous lot rubber which consisted mostly of grades 4 and 5 is ungraded and unpacked.

A section of the producers and traders has shown a tendency to hold sizeable quantity of rubber in anticipation of price hike as evident from the unsatisfactory arrivals despite the fact that rubber production is in full swing now.

The production in October 1978 registered an all time high report of 17000 tonnes while it was only 11000 tonnes durning the same period in 1977. If the price tends to soar during peak production period it is anybody's guess as to what it could be during lean months ahead. The price of rubber in December 1977 was only Rs. 610 per quintal.

Unless conceited efforts are made by the producers, traders and consumers to bring down price, the feeling that natural rubber is scarce in the country even after allowing an import of 30,000 tonnes would get strengthened.

Shri SG Sundaram, Chairman, Rubber Board while appealing to the different interests of the rubber industry to lend support for bringing down and stabilising the price of natural rubber has warned such traders, consumers and their agents who deliberately attempted to upset the market equilibrium, of drastie action. Rubber producers would do well, the Chairman suggested, if they release the stocks with them and assist in enforcing a price level acceptable to all.

Meanwhile, the Un'on Ministry of Commerce is convening a meeting of the representatives of producers, traders, consumers and concerned Central and State authorities at Delhi on 9th January 1979, to bring about a certain amount of discipline in the trade and determination of a reasonable price range for different grazies of

The Kerala Chief Minister Shri PK Vasudevan Nair while speaking to newsmen at Kottayam last week had disclosed the thinking of the Government of Ke-ala for setting up an agency for monepoly procurement of natural rubber modelled on the Cotton Corpo ation of Maharashira, to bring down and stabilise Rubber price if warranted. A clear picture of the proposal mooted in this regard is likely to emerge after the Delhi meeting on 9th lan iary 1979.

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New Prospects for Natural Rubber in India

This is the text of the speech of Shri Arif Baig, Hon'ble Union Minister of State For Commerce, read by Shri TV. Antony, Joint Secretary to the Ministry of Commerce in the absence of the Honourable Minister at the inaugural session of the Still meeting of the Rubber Board beld at session of the Still meeting of Many 178. The Hon'ble Minister though made, we have a support of the Minister though made with the aircraft carrying but could not land due toadverse weather conflictors.

The Rubber plantation industry occupies an important position in the economy of this country as it provides the principal raw material for the manufacture of a variety of products which are indispensable in modern life. India now ranks fifth among the natural rubber producing countries in the world, the first four being Malaysia, Indonesia, Thailand and Sri Lanka. Cultivation of rubber in India on a commercial scale had started in 1902. By 1925, the area under rubber increased to 31,000 hectares and production to 6,400 tones.

Independent India started with a rubber plantation industry producing only about 15,000 tonnes of rubber. In the thirty years after Independence natural rubber, production registered a ten-fold increase from 15,000 tonnes to a little over 150,000 tonnes. Planted area increased from 63,000 hectares to over 2,30,000 hectares, most of which is located in Kerala State. What is of great importance is that thanks to introduction of high yielding varieties and better cultural practices averagiveld per hectare rose from a mere 300 kgs to presently over 800 kgs. The industry gives direct employment to 170,000 persons. A sizeable number of persons also depend on processing, transporting, marketing and other related activities. The value of the crop harvested annually amounts to over Rs. 110 crores.

The importance of small holdings

Of the total registered area of 230,000 hectares, small holdings of size upto 20 hectares cover 163,000 hectares or 71 per cent. The total number of small holdings is about 137,000. Large estates of size exceeding 20 hectares number only 595. The small holdings at present account for 63 percent of the total production. Thus, by virtue of their number, coverage of area and contribution to production, the small holdings have come to occupy an important position in the industry.

All over the world, rubber has now come to be recognised largely as a small holders' crop. Large estate sector have played an important role in the industry by spear-heading the adoption of modern scientific know-how in cultivation and production.

Consumption

Consumption of rubber also has shown steady progress during the post-Independence period from 19,000 tonnes it rose to about 180,000 tonnes in 1977-8. The sinclude both natural and synthetic rubber. The sinclude both natural and synthetic rubber manufacturing units has deep from about 100 to the present 2,400. In order not about 100 to the present 2,400. In order the consumption requirements, synthetic mubber produced to supplement natural rubber produced to supplement natural rubber and produced to supplement natural rubber and 2,000 tonnes of Styrene Butadiene rubber and 2,000 tonnes of Styrene Butadiene rubber and 2,000 tonnes of Nitrile rubber. A second unit designed to produce annually 20,000 tonnes of Polybutadiene rubber is expected to start production shortly.

The rapid increase in rubber production has transformed this country from an importer of natural rubber to a marginal exporter. During 1975–76 and 1976–77, production exceeded consumption by about 12,000 tonnes per year. The marginal surplus was siphoned off through exports as the same was found to bring about a depressing effect on indigenous raw rubber prices.

Increasing demand

The demand for rubber in India is bound to increase steadily in the coming years with the developments taking place in industrial, agricultural and transportation sectors, and as a result of the increasing efforts to find new uses for rubber. India with its vast area and high population is having only a very low per capita rubber consumption of 0.27 kg, while in developed countries

like USA, UK, France, Italy, Japan, Canada, Australia and Netherlands, it ranges from 6 to 14 kg.

According to the estimates of the Sub Group on rubber of the Working Group on Plantation Crops constituted for formulating proposals of Medium Term Plan for 1978 to 1983, the demand for rubber (natural and synthetics) which is now of the order of 180,000 tonnes is estimated to go up to 250,000 tonnes by 1982–83 and again to 338,000 tonnes by 1982–83. The target for production of natural rubber proposed for 1982–83 is 195,000 tonnes and 1987–88, 260,000 tonnes and spanse per annum. The estimated availability of synthetic rubber during these years is 52,000 tonnes and 62,000 tonnes respectively. The net deficit is to be met by limited imports of special purpose synthetic rubber swhich are not produced in the country.

Expansion of area

The rubber plantation industry has to be geared to meet the increasing requirements and this can be achieved only by increasing the per unit yield and expansion in planted area. The Working Group Plan envisages yield in small holdings in replanted areas to go up from \$50 to 1,000 kgs. by 1982—83 and to 1,150 kgs. by 1987–88. Similarly, in estates yields are expected to go up from 1,050 to 1,150 kgs. in 1982—83 and to 1,250 kgs. by 1987–88. It is also hoped to bring an additional 6,000 hectares under new planting of rubber per year apart from replanting \$,000 hectares per annum. Possibility of expansion of rubber cultivation in the traditional areas are not too good owing to scarcity of suitable land. In this context the States in the North-Eastern with large extends of undeveloped land assume importance.

Trial rubber plantations in Assam and Tripura have established the possibility of successful commercial exploitation. Surveys conducted by the Board in these States have revealed immense potentialities for development of rubber plantations. It would be worthwhile for these States to set apart large areas for rubber cultivation both in the public and in the private sectors.

The experience in the traditional rubber growing areas of Kerala and adjoining districts of Tamil Nadu and Karnataka have shown that development of rubber plantations can bring about scientific land utilisation, generate rural employment and improvement of overall economic status of the region. The North Eastern States with their vast land resources and large number of unemployed or partially employed persons can take advantage of rubber cultivation to usher in a new

economic base. Tripura in particular has extensive dry lands at present lying fallow under Government or private ownership. These could be developed into hundreds of high yielding rubber plantations.

Board's activities

The Rubber Board has already set up an extension unit in Tripura and it is going to establish a Regional Research Centre in the State for which preliminary steps have already been taken. The Board has certain schemes for assisting the plantations and it is hoped that new entrepreneurs the region would come forward to make use of the same. However, the Board's activities in this region should considerably go up, so that the much needed development in the North-Eastern region may take place without delay.

Natural rubber produced in the North-Eastern tractices could for the present find a ready market in Calcutta which has been the traditional centre of rubber manufacturing units in the country. These units are at present consuming at the rate of 30,000 tonnes of natural rubber per annum. In due course, the North-Eastern States could themselves set up rubber goods manufacturing units and thereby develop the much needed industrial base for the region. The Rubber Board could assist the States in this respect also by providing stechnical know-how and other advice. Development of a local market for rubber would enable realisation of attractive prices for the raw produce.

Development

The Government of Tripura has already launched a scheme for developing rubber plantations in the public sector, with a target of plantating 5,000 hectares over a period of 10 years from 1976-77. Assam has also taken uprogramment for controlling the local practice of shifting cultivation, in the hill districts. The Rubber Board has been giving all possible help and support to these plantations by arranging high yielding planting materials, technical advice, training of personnel, etc.

Other States/Union Territories in the region have taken up trial planting of rubber with encouraging results. These might be pursued vigorously with the help and assistance of the North Eastern Council and the Rubber Board so that areas with good potential could be developed with expedition. The States/Union Territories in the region would also take all possible steps to promote rubber cultivation by individual farmers. A well-planned strategy in this direction needs to be evolved in consultation with the North-Eastern Council and the Rubber Board.

India Ranked Fourth Largest Producer of Natural Rubber

SG Sundaram I A S

Chairman Rubber Board

India has moved up from the fifth to the fourth largest producer and grower of natural rubber in the world. This was disclosed by Shri S. G. Sundaram, Chairman, Rubber Board in his opening remarks at the 89th meeting of the Rubber Board held at Agartala. He hoped that India be able to overtake Thailand and rise to the third rank in another decade from now, provided an all out effort is made within the country for intensive and extensive production of rubber. Being the less necessity of the production of rubber. Being the less necessity of the production of rubber and the production of rubber and the production of rubber. extensive production of rubber. Being the lean season, price of rubber had been showing an upward trend in the last couple of months, he pointed out. This should enable the growers to reinvest the material gains they have made back reinvest the material gains they have made back to the plantations for promoting productivity. Areview of both the national and international situation would reveal that natural rubber has a very bright future ahead. The recent meeting of the International Rubber Study Group (IRSA) held in Washington estimated that in 1978 World consumption of natural rubber would be around 3.825 million tonnes and that of general and special purpose synthetic rubbers 8.825 million tonnes. World production of natural rubber and corder of 3.75 million tonnes and that of synthetic rubber in the region of 8.775 million tonnes for the rubber with the rubber of \$0.000 tonnes of synthetic rubber durabber durabber durabber durabber durabber and \$0.000 tonnes of synthetic rubber durabber and \$0.000 tonnes of synthetic rubber duraber. rubber and 50,000 tonnes of synthetic rubber during the year, is almost certain.

Liberalisation of procedure

The Chairman informed members that the Board is taking appropriate steps to liberalise the procedure for the issue of licence for dealing in rubber, so that there could be more trading points for the cowers to dispose off their produce with ease. He also expects that this reform would ensure healthy competition. So also all pending applications for registration of rubber estates would be cleared within a few months. Another proposal which is engaging the serious consideration of the

Board, the Chairman said is the reduction of cess on the natural rubber used for producing rubber goods by small scale industrial units. May be, this would have to be worked out at varying rates for varying slabs of consumption. Such a step like this, he feels, would creat a congenial climate for more small scale industries to emerge in the small scale scator resulting in exports of rubber goods. Production of more rubber goods means increased domestic consumption of natural rubber and generation of new employment. With a view to encouraging new process rubbers the Board has decided to abolish the fees levied for testing them at the Rubber Research Institute of India.

As regards new schemes contemplated now, he revealed that there is a thinking to subsidise all types of rubbr planting irrespective of whether it is new or replanting. Of course, the operational details of such a proposition has to be looked in-

to in all its detail. In order to achieve the targets of production in the coming plans such an integrated approach towards promotion of production of natural rubber is felt essential.

To relieve the rubber market of its present stress and strain, the Chairman suggested buffer stocking of natural rubber within the country as one of the best possible alternatives. He felt that the release of rubber from the buffer stock should be regulated and linked with a price band judged to be economic both to the producer and consumer alike.

The ongoing differences of views within the two vital sectors of the industry on the price and stocks of natural rubber should come to an end, as, he felt, that both these sectors are indivisible and that the industry could not prosper without mutual understanding and adjustment between these two sectors.





The report on 'Rubber Plantation in Tripura' prepared by the Tripura Forest Development and Plantation Corporation Limited, Agartala was presented at the 88th meet-action Limited, Agartala was presented at the 88th meet-plantation of the 1978. The report highlighted the efforts of the Grown ment of Tripura for raising rubber plantations there in a period of 10 years. To step up the plantation programme, the Government formed a Corporation styted as 'Tripura the Government formed a Corporation styted as 'Tripura the Government formed a Corporation styted as 'Tripura 1976. Till 1977, in area of 570.16 hectures has been

brought under rubber. The target fixed for 1978 is 500 inctures. By the end of 1978, an area of 1370 betteres says that the post under rubber cultivation. The report says that the post under rubber cultivation in the report says that the post under the rubber cultivation in traditional areas of the Section Tripura and other broad areas of the Section Tripura and other broad traditional areas of the section to the section of the section o

Rubber Plantation in Tripura

The first rubber plantation was taken up in Tripura by the Forest Department in 1963 on an experimental basis. Since then the Forest Department continued the planting programme every year on a limited scale in different places. The oldest plantations raised in 1963 were brought under

tapping in 1971 after 7 years of growth. The general performance of the plantation, yield, and quality of the later, produced confirmed the prospect of natural rubber production in Tripura. On the recommendation of the Rubber Board whose Officials visited the State from time to time, it was therefore decided by the Government to go in for large-scale plantation and accordingly plantation programme was stepped up from 1972-73 by the Forest Department.

The important rubber growing areas of the World are confined to the tropical regions lybetween 10° South and 15° North of the Equator. Tripura which is situated between 20°and 24° North Latitude does not therefore lie within the conventional rubber growing zone. Special geographical situation obtaining in certain areas can, however, bring about near tropical conditions in sub-tropical regions and Tripura appears to be one such exceptional region. Annual rain fall, its distribution pattern, elevation and lie of lands, temperature, soil conditions, humidity etc. obtaining in various parts in Tripura have been found to be suitable for rubber.



With a view to further stepping up the plantation programme, the Government formed a Corporation styled as "Tripura Forest Development and Plantation Corporation Limited: In 1976 with a project for raising rubber plantation over 5000 ha. in a period of 10 years. During the first 2 years the Corporation has already covered the targeted area of 190 ha. in 1976 and 300 ha. in 1977. The proposal in 1978 is to raise plantation over 500 ha. The area under rubber upto 1977 is \$70.18 ha. including 419.18 ha. raised by Forest Department upto 1975 which has come



under the Corporation management. The Corporation is developing 8 Estates namely Juri, Ratachara (including N. C. Para) in North Tripura District, Rupachara, Pathalia (including Warangbari) in West Tripura District and Patichari, Kalashimukh (Kakulia), Sachirambari

and West Ludhua in South Tripura District. The plantations are being raised on Government lands mainly in reserve forests transferred to the Corporation for the purpose. Plantation area at different places upto 1977 is as follows:—

(Area in ha.)

	Patichari	Manu	Pathalia (including Warang- bari)	Kakulia (in- cluding Kalshi- mukh)	West Ludhua	Sachi- rambari	Rata- chara	Juri	Rupa- chara	Total
1963	3.00	2.80				-				5.00
1964	4.40		3.50	3.88						5.80
1965	12 00		4.00							11.78
1966	4.00									16.00
1968	0.95				4.05					4.00
1969	5.00		3.80	3.60	0.50		111			5.45
1970	3.15			2.00	111					12.90
1971	6.70		23.50	2.00						5.15
1972	6.00		10.00	2.00		***				32.20
1973	33.45		14.45	2.00		35.00	20 00			18.00
1974			14.00			50.00	40,00			102.90
1975			6.00			40.00	55.00			104.00
1976			20.00	10 00		40.00		20.00		101.00
1977	45.00		30.00	30.00	15.00		43.00	20.00	15.00	148 00
1211	45.00		30.00	30.00	15.00	30.00	53.00	60.00	40.00	303.00
	123.65	2.80	129.25	53.48	20.00	195.00	211.00	80.00	55.00	870,18
1978 (pro-										
posed)	41.00		75.00	43.00	27.00	70.00	75.00	85.00	84.00	500.00
	164.65	2.80	204.25	96.48	47.00	265.00	286.00	165.00	139.00	1370.18

Planting Material

Earlier the plantations have been raised with Tjir-1 Clonal seeds either by transplanting of nursery raised seedling stumps or by "Seed-atStake" planting. Budded stumps of high yielding strains were also raised to a limited extent. But as according to the Rubber Board rubber plantations are to be raised only with high yielding strains, the plantations are now being raised with budded stumps or with "Seed-at-Stake" planting and then field budded subsequently. The Corporation has already established budwood nurseries in different plantation centres totalling about 25,000 budwood mother plants. Some of the important varieties which have been raised are RRIM-600, RRIM-623, GT-1, PB-5/51 etc. The nuclei were brought from approved private nurseries in Kerala with the help of the Rubber Board. Seedling nurseries are raised every year according to requirement. 2465 nursery beds of 12.2m×1.2 m size were raised in 1977 and about 2.5 lakhs seedlings will be available in 1978 for budding. Besides, 0.5 lakh seedlings are also available for budding from the 1976 nursery, Local seeds from older plantations have started

becoming available and only some excess requirement is met by bringing seeds from approved Rubber Estates in South India.

Local persons are engaged for budgrafting. This is a skilled job and it will take several years to achieve perfection. At present expert budders are brought from Kerala to train up the local boys in budding and to supplement budding to meet the huge requirement of budded stumps. During 1977–78 budding demonstration and training programme was arranged under the aegis of the North Eastern Council by bringing 4 skilled budders from Kerala.

In the North Eastern Region, Tripura has started rubber plantation on an extensive scale for the last few years. To help the other neighbouring States to take up plantations, Tripura Forest Development and Plantation Corporation Ltd, supplied 503000 rubber seeds, 1359 rubber stumps, 420 metres of budwood during 1976-77 and 267000 rubber seeds, 11450 rubber stumps and 115 metres of budwood during 1977-78. Requests have been received for supply of seeds budded stumps and budwood for the 1978 season

also. The Corporation is trying to meet the requirement of the neighbouring States to the extent possible. The Corporation is also helping the private growers by extending technical advice and assistance and by supplying planting materials. So far II growers have already raised plantations over 36.75 ha.

Tapping and Yield

The oldest plantations were brought under tapping from 1971-72. During 1977-78 the gross area upto 1969 plantations under tapping was 55,93 ha. in 5 different centres. The production was 28 M. T. The per ha. average yield apparently is much less when compared with the all India average of 806 kg. It needs mention here that in Tripura the older plantations which are now under tapping were raised with clonal seeds. This is as against 75% area under high yielding or moderately yielding clones on all India average. Further the older plantations are thinly stocked and only 215 trees are under tapping per ha. on an average. The reasons for such thin stocking are mainly because the plantation was raised to study its success without attempting much for vacancy filling and due to heavy wind damage. Another important reason of low yield may be attributed to bad and defective tapping. Local persons are engaged for tapping. They will take some time to reach perfection. In the process the supported by the fact that the yield from 1968 plantation at Manu is 75 kg. per ha., the number of trees per ha. being 480. Now a days, tapping demonstrations are being arranged by bringing demonstrations are being arranged by bringing demonstrations from Kerala to improve the efficiency of the tappers. A reaning school will be set up in the near fluture rations occasionally. For training of tappers.

Plantation Problems

Though the initial difficulties of raising plantaseedling nursery etc., are by and large being overcome, other post plantation problems like management of rubber estates, matters relating to tapping, processing, smoking etc. diseases, marketagrad utilisation of raw rubber etc. have started
cropping up. As kne local budders are yet develop, the skill fully, success of budding is
unsatisfactory which results in wastage of planta
materials, wasteful expenditure and heavy
vacancies in the plantations. The pest attack and
diseases are also causing heavy casualizes in the
nurseries and in the immature plantations. Its
however fortunate that older plantations are still

free from major pest attack or diseases but this may be because rubber is being grown for the first time. It is feared that diseases and pests may pose problems in mature plantations also in course of time as the plantation programme progresses. Rubber plantation has started comparatively in a big way but the present level of technical competence is not adequate to implement such large scale programme. Arrangement is being made to get the supervisory staff trained in rubber culture. During 1977-78 one Ranger was trained in rubber culture course conducted by the Rubber Board under the N. E. C. programme. During this year there is proposal to send 6 Officers for the same training.

Rubber Board has a Sub-Office at Agartala. One Asstt. Development Officer is stationical. He alone is not able to look after the nector of the area. It is urgently necessary to have a untible and fully equipped organisation of the Rubber Board to cope up with the increasing problems. The necessity was felt by the Chairman, Rubber Board long back during his visit to the State in 1973 as evident from his report which says "considering the bright prospects for rubber cultivation in the North Eastern Region and the interest shown by the Governments in the Region, the Board has decided to strengthen its organisational set up in the region, with Agartala as Headquarters for offering the required technical advice and assistance on a more extensive scale than at present." The matter was taken up with the Rubber Board. They have recently intimated that the proposal for strengthening the organisational set up of the Rubber Board in Tripura is under active consideration. It is also heartening to note that the Regional Research Station of Rubber Research Institute of India will also be set up in Tripura. It is equally heartening that the North Eastern Council.

Area and Production of Natural Rubber in the Country

The principal rubber growing States in the country are Kerala, Tamil Nadu and Kannataka. Of late rubber plantations have been taken up in Andaman and Nicobar Islands, Andhra Pradesh, Goa, Mabarastra and in the North Eastern States including Tripura.

According to 1976-77 Rubber Board statistics, the area under rubber in India is 29053 ha. Kerala alone has 209723 ha. which comes to 91%. Tamil Nadu has 11570 ha. i. e. 5%, and Karnataka 7763 ha. i. e. 3.4%, and other States total to only 1505 ha. i. e. 0.6%.

Most of the rubber is grown in small holdings. In all 136532 units cover an area of 163084 ha. and 595 estates have 67479 ha, area under rubber. Further 86% of the holdings are of 2 ha, area or below comprising of 52% of the total area. Only 1% of the units is between 10 ha, to 20 ha-

The tappable area is 185600 ha, and the production is 149632 M. Tones. Rubber plantations have recorded spectacular progress of late. From 65376 ha, in 1948-49, the area has jumped to 230563 ha, in 1976-77, an increase of 253%, Similarly the production has increased from 15394 tons in 1948-49 to 149632 tons in 1976-77. The increase is 872%, The rate of increase of production of rubber per ha, is from 320 kg to 806 kg, during the same period being 151%.

Today about 46.5 percent of the Worlds production of 3525000 tones of rubber comes from Malaysia, 24 percent from Indonesia, 11 percent from Thailand and 4.3 percent from Sri Lanka. Other rubber producing countries are India, Liberia, Nigeria, Viet-Nam, Combodia, Brazil. As a result of India's emphasis on import substitution, rubber plantation has come to gain increasing importance in our country.

The international statistics on rubber indicate that the increase in rubber production in India is the highest in the World and as a result India has become the 5th largest rubber producer, the other 4 countries being Malaysia, Indonesia, Thailand and Sri-Lanka. Out of the World production of 3525 thousand tonnes of natural rubber India's contribution is 148 thousand tonnes; i. e. 4.2%.

At present India is producing sufficient rubber to meet the domestic requirement of rubber goods manufacturing industries. It has stopped import since 1974-75 and has started export to Japan, West Germany, France, Italy, Natherlands, Singapur, Sudan etc. 2700 M. tonnes during 1974-75, 350 tonnes in 1975-76, 12296 tonnes in 1976-77 were exported.

In the North Eastern Zone of the country which is the new home for rubber, Tripura now is on the top. Other adjoining States such as Assam, Nagaland, Manipur, Arunachal Pradesh, Mizoram have also taken up rubber plantations. West Bengal has started raising rubber on an experimental basis for the last two years.

Along with the production the internal consumption is steadily increasing. As against consumption of 19834 tonnes during 1930-51, the figure is 137623 tonnes during 1976-77. The demand for rubber in future in India is bound to increase steadily with tht developments taking place in the industrial, agricultural and transportation sectors and as a result of increasing efforts to find new uses for rubber. India with its vast area and

high population is having a very low per capita rubber consumption of 0.27 kg, while in developed countries like U. S. A., U. K., France, Italy, Japan. Canada, Australia and Netherlands it ranges from 6 to 14 kg, and in China it is around 0.35 kg.

The overall World production and consumption of natural rubber also are equally increasing steadily as is evident from the following.

	1966	1971	1976
Production of natural rubber in principal territories. (in thousand tonnes)	2393	3085	3525
Consumption of natural rubber in main consuming countries. (in thousand tonnes)	2543	3095	3545

The trend will continue and the projected World demand of natural rubber in 2005 A. D. is considered to be 7.5 million tonnes. Natural rubber is imported by Australia, Finland, Greece, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, Yugoslavia, Bulgaria, Czechosłovakia, G. D. R., Hungary and the countries of Western Europe.

Scope for Future Expansion

Seeing the success of rubber plantations raised on Government lands, the people of the State have become very much interested to take it upon their own lands. In fact, some progressive enterpreneurs have already raised rubber plantations. The scope of taking up large scale rubber plantations on Government land by Government agencies is limited. On the other hand, considerable area suitable for growing rubber under individual ownerships are available all over the State and roughly S0000 ha. may be available for raising rubber plantation. Such a scheme on small unit basis will catch up easily. In Keral there are 1.33 lakhs small growers covering 1.57 lakhs ha. area (1976–77). Considering limited scope to expand the area under rubber in the traditional rubber growing States in South India and considering that Tripura and other North Eastern States have been found to be the alternative home of rubber, the large-scale rubber plantations in Tripura will help considerably towards meeting the countries own increasing requirement of rubber seel as the export potentiality.

But large scale coverage by small and private growers can not be made without adequate financial support and extension service. The Rubber Board has various aid schemes to help the private growers which are now operative in the traditional rubber growing States in South India. The matter regarding extending the aid schemes of the Rubber

Board for the small growers in Tripura was taken up with the Rubber Board and it has been recently intimated that the proposal is under their active consideration. This needs to be finalised early with suitable modification to suit the actual needs of the state so that large-scale extension of area under rubber in Tripura is possible.

Employment, Rural Economy and Rehabilitation of Landless

It is estimated that every 1.5 ha, of rubber plantation up to the 7th year provide employment to 1 person. It is also estimated that 1 (one) person will get employment as tarp to 2 ha, of area when the plantations come under tapping. This is besides large number of persons required for other works. When the area of 5000 ha, of rubber plantation being raised by the Corporation comes under tapping, it will provide permanent employment in the rural and interior areas to 2500 tappers alone besides other categories being employed. In raising the plantations, the Tripura Forest Development and Plantation Corporation Limited will be able to generate employment annually during the project period of 10 years as follows:—

Year	Mandays
1976—77	1.05 lakhs
1977—78	1.69 ,,
1978—79	2 62 ,,
1979—80	3.34 ,,
1980-81	3.93 .,
1981-82	4.89 ,,
1982-83	5.76 ,,
1983-84	6.51 ,,
1984-85	7.47 ,,
1985-86	8.95 ,,

The employment potential will increase substantially if the expanded plantation programme through the small growers is taken up with the Aid Schemes of the Rubber Board. This will greatly help in solving the rural unemployment problem as well as providing full time work to hitherto underemployed landless agricultural labourers. Such a programme will make best utilization of vast tilla area not suitable for permanent agriculture and now almost lying fallow.

Rubber planting is capital intensive. Creation and maintenance cost including cost of fertiliser

during the immature stage of plantation of 7 years comes to Rs. 7500/-to 8000/s. This again being a labour intensive programme, bulk of the amount is spent as wages. Rubber plantations are being raised in the rural areas where the major population consists of tribals. Such heavy investment of money will improve the economy of the Considering that Rs. 4500/- will be spent as wages alone per ha. the flow of cash for 5000 ha. will be Rs. 2,25 crores.

In Tripura the programme of rubber plantation has also been linked with Jhumia Rehabilitation programme of the Forest Department. A Ratachara so far 211 ha, rubber plantations have been raised during the period of 1973 to 1977 and 100 Jhumia families have been settled. All these families get regular employment in the plantations. These families have been provided with cultivable lands after reclamation, agricultural inputs, orchards raised at Government cost with their own labours, water areas for piscienture, dwelling house etc. It is estimated that there are more than 16000 Jhumia families who are engaged in Jhuming in the forests and require permanent settlement. The general terrain of the State is mostly undulating and hilly with only 20% plain area. In view of the non-availability of arable land, there is little scope to rehabilitate all such families in agriculture. Large scale plantation programme will help in settlement of landless people by providing them full time work in the plantations and other facilities such as housing, education, medical etc. and wearing them away from the age old destructive practice of shifting cultivation.

Conclusion

The ever growing demand for natural rubber offers tremendous scope for further development in this field. A scientific study apply of the study of t

Washington Assembly of the International Rubber Study Gorup

Following is a report of Shri. P. Mukudan Menon, Rubber Production Commissioner on the 25th Assembly of the International Rubber Study Group (IRSG) held in Washington from June 19—23, 1978. The Government of India had deputed Shri Menon to Washington to attend the Twenty-Hifth Assembly of the IRSG. His impressions on the deliberations of the Assembly are impressions on the deliberations of the Assembly are Covernmental Organisation and the IRSG is an International Covernmental Organisation and IrSG is an International Covernmental Organisation and IrSG is a covernmental Organisation

P Mukundan Menon,

Rubber Production Commissioner, Rubber Board, Kottayam 686 001

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The Group has at present 30 members. A meeting of the Group is conducted every year. Assemblies are at present held once in three years.

The Group is the only international forum representing producing and consuming interests in respect of both natural and synthetic rubbers,

Opening of Twenty-Fifth Assembly

The Twenty-fifth Assembly was convened in the International Conference Room of the Department of State Building, Washington, D. C. at 10 A. M. on Monday, June 19, 1978 at the invitation of the Government of the United States of America. The Assembly was declared open by the U. S. Assistant of State for Economic and Business Affairs, Mr. Julius L. Katz. Representatives of twenty-seven member countries with their advisers, and observers from thirteen international and other organisations attended the Assembly. The details of the number of participants are given below:

SI. No.	Country/ Organisation	Dele- gates	Advi- sers	Obser- vers
(1)	(2)	(3)	(4)	(5)
			(')	(0)
1.	Australia	1		
2.	Austria	2		
4.	Belgium Brazil	1 4		
5.	Cameroon	1		
6.	Canada	1	6	
7.	Czechoslovakia	1	0	
8.	France		9	
9.	Germany, F. R.	2 7	,	
10.	India	- 1		
11.	Indonesia	11	1	
12.	Italy	1	4	
13.	Ivory Coast	1		
14.	Japan	1	6	
15.	Liberia	6		
16.	Malaysia	7	4	
17.	Mexico	1 3 3 2 2 2 2 7 2 2 2 2 2 2 2 2 2 2	1	
18.	Netherlands	3	1	
19.	Nigeria	3		
20.	Poland	2	1	
21.	Singapore	2	5	
22.	Sri Lanka	2		
23.	Sweden	2		
24.	Thailnad	7		
25.	U. S. S. R.	2		
26.	U. K.	2	11	
27.	U. S. A.	2	16	
28.	Association of Natural			
	Rubber Producing Countr	ies.		1
29.	Bureau De Liaison Des			
-	Industries Du Caoutchouc			1
30.				
30.	Economic Community.	cun		2
0.1				
31.		the		
	Commission for Asia and the Pacific.	tite		- 1
				1
32.				
	Conference			1
33	Food and Agriculture			

(1)	(2)	(3)	(4)	(5)
34.	International Bank for Reconstruction and Development			1
35.	International Institute of Synthetic Rubber Producers			3
36.	International Monetary Fund			2
37.	International Rubber Association			2
38.	International Rubber Research and Development Board			1
39.	United Nations Conference on Trade and Development			1
40.	United Nations Industrial Development Organisation.			1
	Total	76	65	18

The U. S. Assistant Secretary of State in his opening address analysed the current trends of changes of elastomer (NR and SR) market and attempted to outline the possible future prospects. According to him, the world demand for elastomers is likely to grow at 5% annually over the next 15 years or so. The energy situation has altered the competitive relationship between NR and SR and NR has acquired a substantial improvement in its ability to compete in elastomer markets. Replanting and technical unrovations will allow NR production to climb from its historic average growth of 5% annually to perhaps the strength of the strength of

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Commodity Agreement for Natural Rubber

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- (a) An international buffer stocking system as the central element of a price stabilisation agreement, which could take the form of an international buffer stock as the instrument of price stabilisation; or an international buffer stock supported by supply rationalisation measures as a contingency mechanism, as and when necessary.
- (b) The international buffer stock large enough to ensure its effectiveness as the central element of a price stabilisation agreement.
- (c) Pricing provision cast so as to promote the long-term equilibrium between demand and supply within an expanding natural rubber world trade. These provisions could take the form of a price stabilisation range including trigger points for buffer stock acquisition and disposal which would be remunerative to producers, fair to consumers, ensure adequate supplies, and wide enough to serve the purpose of the agreement. Such price ranges should be periodically reviewed and, if necessary, revised.
- (d) A balance between producers and consumers of rights, obligations and benefits, in any possible international stabilisation agreement on natural

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16.	Malaysia	7	4	
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28.	Association of Natural	-	, 0	
	Rubber Producing Countries			1
29.	Bureau De Liaison Des			- 1
29.	Industries Du Caoutchouc.			1
20				-1
30.	Commission of the Europea Economic Community.	n		2
31.	Economic and Social			
	Commission for Asia and th	e		
	the Pacific.			1
32.	Far Eastern Freight			-
	Conference			1
33.	Food and Agriculture			1
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- (d) A balance between producers and consumers of rights, obligations and benefits, in any possible international stabilisation agreement on natural rubber.

The Secretary-General of UNCTAD has been requested to convene the negotiating conference in late October/November, 1978. In the mean time, a consumer meeting will be organised in time to enable the consumers to produce a coordinated draft/drafts by 18th July, 1978 and a drafting group of both consumers and producers would be convened in September, 1978 to combine and produce a single working draft for the negotiating conference.

Studies on Future Market Share of Natural Rubber

The Assembly was presented with reports of preliminary studies on the above subjects drawn up by the Groups' Ad Hoc Advisory Panel. Though the information furnished and items expressed in the reports were considered to be useful, some delegations felt that in-depth studies were still to be undertaken. It was decided that the Executive Committee should consider how the Group and its Secretariat could be strengthened to undertake comprehensive study on future

market share of NR at a stable price. As regards establishing dialogue between NR and SR producers, it was suggested that the Groups' former consultative committee of NR and SR producers be revived in order to foster co-operation more positively. In order to ensure prevention of unnecessary proliferation of committees, it was decided to remit the suggestion to the Executive Committee for closer examination and recommendations.

Maritime Transport of Natural Rubber

The ever increasing shipping freight rates which worked against the interests of NR producing countries has been a long standing exactious subject in the Groups' necelings for some time past. The matter came up for extensive discussions at the Assembly to decide as to what IRSO should do to help improve the situation. Member Governments, whilst noting that it would be inappropriate for the Group to duplicate the activities of other international bodies concerned with freight rates, decided that they require the Group to have a specific involvement in the study of shipping matters. To this end, the Executive Committee was charged with the extablishment of a suitable body concerned with maritime transport of natural rubber. Indonesia, Malaysia, Nigeria, Thailand and Singapore representing exporting interests and the Netherlands, U. K., U. S. A., Italy and Japan representing importing countries would form the committee with the Secretary General of the Group as Chairman. The committee would be known as the Committee on Maritime Transport of Natural Rubber. The terms of reference for this body were agreed as follows:

- to examine freight rates for the shipping of natural rubber;
- ii. to consider how information on the rates for maritime transport of natural rubber may be included in the Groups' statistical publications:
- iii. to consider the implications of trends in freight rates and the scope for action by producers and consumers to protect their interests in this regard;
- iv. to review technical developments that could improve the efficiency of shipping and handling natural rubber;
- v. to liaise with other international organisations with kindred interests;
- vi. to report to the Gruop at such times as deemed necessary.

The Assembly heard statements from representatives of ANRPC, IRA, IRRDB and IJSRP on the progress of activities with each of those.

Statistics

After examining the report of the Statistical Committee in detail, the Assembly arrived at the estimate that in 1978 world consumption of natural rubber would be near 3.825 million tonnes, and of general and apecial purpose synthetic rubber, 8.825 million tonnes. World production of natural rubber was expected to be about 3.75 million tonnes and that of synthetic rubber in the region of 8.775 million tonnes. The projections indicate a possible shortage of 75,000 tonnes of NR and 50,000 tonnes of SR during the year.

Constitution

The Assembly approved amendments to the Groups' constitution as required mainly to secure consistency with the terms of Headquarters Agreement with the Government of the United Kingdom. This was in consequence to the Group signing an agreement with Government of U. K. by which the latter had recognised the Group as an international body in that country and had guaranteed the usual privileges and immunities that could be enjoyed by the Group as such.

Budget

After detailed discussions, the Assembly accepted a budget with expenditure of £ 106,000, receipts of and £ 106,00 subject to final approval by Governments in home countries. The estimated expenditure for 1978-79 was lower than the actual expenditure for the previous year consequent to the benefits derived by the signing of Headquarters Agreement with the Government of U.K. The membership contribution by India for 1976-79 could accordingly be £ 2,895 as against £ 3,001 of the previous year.

Meeting of Heads of Delegation and Executive Committee

A meeting of the Heads of Delegation and Executive Committee was held from 9 A. M. to 11.30 A. M. no 20th June, 1978. I participated in the meeting on behalf of the Government of India. The meeting examined the budget and reports of Executive Committee and Statistical Committee and finalised its recommendations to the Assembly.

The Assembly re-elected Malayasia and Japan as Chairman and Vice Chairman respectively of the Group for the year 1978-79.

The Executive Committee was re-elected en bloc. It comprises the U.K. (Chairman), Indones (Chairman), Indones (Chairman), United Republic of Cameroon, Fed. Capablic of Germany, Japan, Nigeria, Thailand, Sandaran of the Group, is a member ex-officio. As usual member governments would be invited to participate in all meetings of the Executive Committee which will normally be held in London.

Discussion Forum

As part of the Assembly, an open Discussion Forum was held on 21st and 22nd June respectively on (a) "Outlook for Elastomers—Challenges and Opportunities of the Energy Situation" and (b) "Guayule as a source of Natural Rubber."

Under the Chairmanship of Mr. Malcolm Lovell Jr; President of the Rubber Manufacturers' Association, United States, Dr. I. D. D. Ianni, Director of Research, Goodyear Co., U. S. A., Tan Sri Dr. B. C. Sekhar, Controller of Rubber Research, Malaysia and Mr. D. A. Bennett, Chairman, International Synthetic Rubber Co., U. K. gave stimulating contributions to the first subject on the rubber manufacturing, the natural rubber, and the synthetic rubber escents respectively. They were supported by distinguished speakers from France, the Fed. Republic of Germany, Japan, Sri Lanka, U. K. and U. S. A. under the Chairmanship of Dr. Ralph Rowzee, Hon. Chairman, Polysar Ltd, Canada, Dr. N., Vietmeyer of the National Academy of Sciences U. S. A., Dr. E. Glymph of the Firestone Rubber Co., U. S. A., Dr. E. Compos-Lopez. Director of the Guayule Project, Mexico and Dr. D. Rubis, Professor of Plant Science, University of Arizona, U. S. A. gave informative accounts of developmental work on the growing of the Guayule shrub and the extraction and properties of its rubber, and discussed the possible economic and commercial potential of guayule rubber.

An extensive and lively discussion followed presentations on each subject.

It emerged from the discussions that the gap between production and consumption of elastomers would keep widening in the years to come it was however felt that plastics might make ineroads into possible new uses of rubber unless natural rubber could be made available in forms which would meet the new requirements. Tan STAD, Sekhar explained the new research and dispinential approaches being made by NR or the production of the production policy of ANRPC countries and expressed the confidence that the challenge facing NR would be effectively met.

Production of rubber from Guayule shrub, it was stated, was being vigorously pursued by the Government of U.S. A. and Mexico and supplemented by efforts from Firestone Rubber Co. etc. The results so far achieved were stated to be promising although a long way had to be covered for making production and processing of Guayule rubber economically competitive. Research was also called for improving the quality of the rubber in order to bring it on par with that of natural rubber.

Future Meetings

It was agreed that the next meeting of the Group should be held in London sometime in mid 1979. As regards the next Assembly due to be held in 1981, no country came forward with offer for hosting. The Group's Secretariat would take up the matter in due course and give the member governments necessary advance information.

Plans and Strategies for the Development of Smallholdings*

The rubber industry in South-east Asia is characterised by the preponderance of small farmers who own and cultivate some 67% of the total planted area in Malaysia, 78% in Indonesia, 35% in Thindiand, 55% in Sri Lanka and a substantial portion in India. Together that a substantial portion in India. Together 17.1 million of the total of 17.1 million acres of rubber land in the world today. Most of the smallholdings are less than 10 acres and are widely scattered in the conditions, difficult terrain and is not overly sensitive to management standards that the confidence of the small man has been generated in the cultivation of Hevea. Plexibility in the demand for agro-management signature and for agro-management inputs and fexibility in the scale of production and processing have made natural rubber an almost ideal crop for small-holders. To meet the supply requirements for the 1980s and beyond, it is manifestly necessary that the confidence of the small man in the rural sectors of South-east Asia be not only sustained but enhanced. There is thus a compelling need to modernise the smallholder operations. This involves the very serious problem of resource allocation by producing countries who are hard pressed by enumerous priorities to attend to this requirement even modestly. There is general understanding, however, that as a crop which can generate the highest form of benefits from the sectio-economic viewpoint, Hevea has very little competition. This must entail an obligation on the part of planners and decision-makers in the producing countries of the world to ensure situations which are conducive to smallholders' enthursiasm and enlarged participation in the rubber industry.

Further there are national and international factors dictating the importance of not only modernising but expanding the shallholder sector. Nationally, because in each rubber producing country, the smallholder operations represent a major component of the complex socio-economic framework of the countries concerned. Internationally, because natural rubber is going to

Tan Shri Dr BC Sekhar

Controller of Rubber Research and Chairman of Malaysian Rubber Research and Development Board

become an even more vital material in the future than it has been in the past and if this material is to come forward in the quantities that will be needed, then its production has got to be seen as worth while by those who rely on it for their very livelihood.

An integrated strategy and approach is imperative to the development and modernisation of smallholdings. The nature and problems associated with rubber smallholdings vary among producing countries but to a large extent, the symptoms, "diseases" and "problems" are surprisingly common. The definition of a smallholding differs from country to country. In India, 50 acres and less is considered to be a smallholding in Indonesia it is 62 acres and less, in Malaysia 100 acres and less, in Sri Lanka a smallholder is one with less than 10 acres. In developing a general strategy for smallholdings it is essential that country examples be used for providing experiences. In this context, the Malaysian story has much to contribute and may provide an effective base to build up the required integrated straters.

Problems of Smallholdings

The problems of smallholdings primarily stem from their small sizes. Although smallholdings are defined as planting units under 10 acres in Malaysia, the vast majority fall under 100 acres, perhaps clustering around the region of 2-5 acres. As accurate data on smallholdings is yet lacking, information on this and other issues remains scattered in the different organisations. It is, however, estimated that there are well over 450,000 smallholdings in the country, and the situation of uneconomic holdings is aggravated by the presence of 'absentee landlords' and the 'share cropping' system. Firstly, ownership of smallholdings through inheritance laws passes on to urban dwellers who tend to operate the holdings on the 'share cropping' basis. Secondly, migration of rural youth to the urban sector leaves holdings in the hands of aged parents who are forced to hire scarce tapping labour. Such practices have become widely prevalent, resulting in limited moome from uneconomic holdings being necessarily shared between owners and hired workers.

^{*} The keynote address delivered by Tan Shri Dr. BC Sekhar at the ANRPC Conference held at Cochin on 24 November 1977.

As a consequence of the uneconomic operation, a number of handicaps must be faced by the small farm sector. These are:

- (a) Loss of income during the replanted immature phase inhibits or retards movement towards replanting and modernisation. In effect, even today, more than 35%, of the small farm sector remains unreplanted, and not all those replanted areas are under the best proven materials.
- (b) Lack of financial backing or easy credits inhibits the use of modern agronomic practices which further reduce productivity. Even today the national average yield of the small farm sector remains under 800 kilo per ha when materials capable of yielding more than 2,000 kilo per ha were already available in the sixties.
- (c) Because of the scattered nature of holdings and their small sizes, modern processing technology cannot be absorbed, thereby reducing returns for product substantially. The majority of production in the smallholder sector is still graded as RSS 3 and below.
- (d) Being dependent on the daily income from their produce for their livelihood, they are inhibited from group and central marketing activities. The production and sale of wet sheets by smallholders to the complex trade results in unnecessary loss of weight, down grading of product, etc., all of which further reduce the return to small farm operator.
- (e) Although there are as many as 450,000 small-holdings occupying more than 67% of the land under rubber and exporting more than 55% of total Malaysian rubber, the small-holders continue to operate without proper organitations at the ground level. The existing Council and new Association are still to establish properly organised groups at ground level. The Farmers' Organisation Authority (FOA), the co-operatives and other groups have not so far made any significant inroads in this respect. The group processing centres which represent another form of smallholder co-operation are still limited in

Solutions Available

1. Agronomic

(a) Commercially proven high yielding planting materials are available which could assure average yield in excess of 2,500 kg per ha. More than 35% of the smallholder acreage remains unreplanted.

- (b) Commercially proven techniques are available to stimulate the flow of latex from old trees on the ground. This would be of immediate benefit at least to 30 to 40% of small farms in one way or another. Application of stimulants however requires adequate fertifisation. This would entail an organised approach with easy credits.
- (c) Techniques are available to provide some form of return for the smallholder during the immaturity period. This includes:
 - (i) organised sale of rubber wood and
 - (ii) the adoption of intercropping/catch cropping. The need is for organising a proper marketing system and a discriminating policy on the choice of intercrops in relation to location.
- (d) Techniques are now available for reducing the immature phase to 3 to 3ly years. This would require decentralisation of nurseries and proper organisation of logistic support.

2. Processing and Marketing

- (a) New processing methods under the SMR Scheme can be applied to the smallholder sector through central factories. There is now no reason as to why smallholder rubber in the long-term should not all appear as the most optimal grades under the TSR Schems. All technical problems associated with the processing of rubber in central factories have been overcome.
- (b) The interim solution of group processing centres for upgrading sheet rubber and providing marketing flexibility to smallholders can also be applied widely.
- (c) While latex purchases can be conveniently carried out through smallholder represenatives, the same cannot be easily done for wet sheets and cuplump. However, the Government through the price stabilisation programme, has established a smallholder rubber direct purching unit. This can be evolved into a proper mechanism for purchasing solid rubber from smallholders for central factory operations.
- (d) While the establishment of Group Processing Centres (GPCs) require process control and central processing units, smallholders' group marketing centres (GMCs) could be formed more expeditiously to sell rubber directly to a central purchase organisation for processing and sales through central factories.

3. Economic Consolidation

(a) Through land settlement schemes and analysis of income accrued under different price

conditions it has been shown that the minimum economic size of rubber smallholdings should be at least 10 acres. In the case of oil palm, the minimum acreage at favourable price levels can be significantly lower. Mixed farms of rubber and oil pall would optimise on employment and return with less hand utilised per consolidated unit.

- (b) Consolidated plantations can be operated with benefits of economy and technology of scales. Smallholders can work on such plantations for income while being allotted shares.
- (c) Smallholders can be employed on consolidated plantations with assured minimum income and retire from the occupation with usual benefits and naming a family member as successor.

This is an area in which adequate thought, discussions and planning have not been given. The difficulties are:

- (i) the inheritance laws
- (ii) the reluctance of smallholders to move
- (iii) the future of scattered smallholdings considered uneconomic
- (iv) the period involved in developing large composite plantations
- (v) the need to tie up share ownership with plantation work for optimising family return and
- (vi) the lack of land adjoining existing smallholdings for consolidation.

4. Credit Facilities

- (a) The smallholders have proven their credit worthiness both in relation to fertilisers and stimulants. Organised approaches through the Rubber Research Institute and Rubber Industry Smallholders Development Authority (RISDA) have indicated that the essential requirements are:
 - (i) availability of adequate finance at low interest rates and
 - (ii) smallholder ground organisation to receive service and repay loans given
- (b) Credit facilities are required by smallholders to establish modern agronomic practices, to provide them with marketing edge and to ensure that they do not become "captive sellers" to the subjective trading system.
- (c) An organised approach without the insistence of collateral and with low interest is essential to make credit facilities meaningful and effective.

5. Ground representation for Smallholders

- (a) There are more than 450,000 smallholders and the only real organised units at ground level are co-operative group processing centres and farmers' organisations. These are few in number and represent only a freemal from the smallholder community. The smallholders cassociation is not as yet effective in all the States and all the districts. The Council of Smallholders (CMSA) is even less represented at ground level. However, the consolidation of these two organisations recently achieved shows great potential.
- (b) As there is a F. O. A. and as a significant proportion of smallholders operate paddy fields or fruit orchards at the same time, the farmers' association concept represents an attractive approach for rubber farms. The limited experience of the R. R. I. with farmers' associations in relation to yield stimulation and credits has been good and effective.
- (e) Ås the F. O. A. is organised around paddy planters, orchard owners and non-rubber agricultural producers, a direct approach to rubber smallholders would indeed be rewarding.

The Integrated Strategy

The problems of the smallholder sector are thus complex and multifaceted. Scientifically and technologically a number of innovations and developments have become available to stem some of the problems. The requirements of the smallholder sector should be viewed in the context of what must ideally be achieved, circumseribed by what can be practically done using available technologies and within the constraints of facilities, finance and organisational limitations. Ideally, of course, economic consolidation of smallholdings represent the "key" to a permanent solution. This is a long-term process and even in the long-term satisfactory methods of approach are yet to be formulated to counter problems of fragmentation, land ownership, inheritance and other socio-

On the other hand, there are immediate technologies available which, if manifest in the smallholder sector nationally, can bring about a substantial improvement in the quality of life in the smallholder sector. Such technologies include

- (i) accelerated replanting with intercropping
- (ii) stimulation with fertilisation and
- (iii) the creation of group marketing centres and purchase depots with central factory processing. Successful implementation of these would require the presence of ground organisations for smallholders and an adequate credit facility.

If the ground organisations can be built around group marketing centres representing an adequate number of smallholders, these could form very viable units for provision of credit. These units should have fulltime managers. Such managers should be employed by the marketing units but paid for by Government in the initial stages. The GMCs can then be progressively evolved into farmers' associations under the FOA. Credit could then be made available through the Agricultural Banks to these units. The viability of the units would depend on their ability to sell rubber easily. This can be assured by the Rubber Industry Smallholders Development Authority (RISDA) establishing regional purchase depots from which the Malaysian Rubber Development Corporation (MARDEC) can undertake to purchase solid rubber for processing in central factories. Such a system will enable smallholders to receive credit and repay them through the marketing units. With such organisational units in establishment RISDA could start implementing stimulation of the smallholding programme, intercropating stimulations pertinent to enclose the smallholding programme available to the units through the Agricultural Bank, with technologies and materials being made available to the units through the Agricultural bank, with technologies and materials being made available to the units through the Agricultural bank, with technologies and materials being made available to the units through the Agricultural bank, with technologies and materials being made available to the units through the Agricultural to a full-time manager, there is every reason to believe that the group marketing units can be evolved that offering the group and to operate central factories viably. Finance cannot be a limiting factor and the Agricultural Bank would be available to fulfill the credit service functions. What is really required is a decisive motional policy and a missionary approach by organisations such as

Programme of Action

Based on such an integrated approach and using Malaysian experience and organisational support a programme of action can be formulated for the smallholder sector of the ANRPC region. These actions could rightly be divided into medium to long-term measures and short-term ones.

Medium to long-term

- (a) Effective accelerated replanting of low yielding smallholdings
- (b) The use of intercropping in the immature phase

- (c) Assurance of the logistic supply of genuine high yielding planting materials and the use of advanced planting materials to reduce the immaturity period.
- (d) Provision of adequate finance to increased costs and credit requirements to implement catch cropping programmes
- (e) Economic consolidation of the very small scattered rubber holdings.

Short-term-immediately

- (a) Improvement in yield of existing smallholdings not subject to replanting. Expertise and experience of yield stimulation. Find the sings are lared a vailable, an assure at least an increase of over 60%, in yield of smallholdings without bark reserves has been shown to beattractive and practical. Both these have enabled, in some circumstances, to increase yield by more than 130%. Better agronomic management with and without stimulation will also enhance yield.
- (b) Improvement of quality of rubber and improvement of processing facilities. Quality improvements to smallholder rubber can be achieved through GPCs and central factories. The viability of GPCs and central factories have already been established.
- (c) Improvement of smallholder marketing strength. Marketing strength of smallholdings can only be improved through formation of collective marketing systems and the establishment of purchase depots. Group marketing centres in operation in Thailand have already indicated efficiency and efficacy of this concept. The experience of GPGs, lend further support. Purchase depots have successfully operated in Sri Lanka. The Indian smallholder marketing co-operative

Conclusions

The NR producing countries are at present seeking international action in bringing about a measure of price stability for NR. Both producing and consuming countries are generally agreed that natural rubber has a strong long-term future. Consumers are concerned that the necessary supplies may not be forthcoming in the years ahead. Producers have been cautious and relate to invest in modernisation and/or expansion because of uncertainties in price levels. It is in these circumstances that the ANRPC agreement on price stabilisation and their declaration of the need for a dynamic production policy should be reviewed. With fresh thinking and emphasis on conservation of non-renewable resources, the need

for improving the quality of life and safe-guarding the environment and the proven techno-economic superiority of biologically-based cis-polyisoprene over its synthetic counterpart, there is a strong case for enthusiastic confidence and optimism for natural rubber. But this confidence must be manifested in an expanding supply of the polymer. This requires the enthusiasm of the smallholder. The seminar and workshop on smallholder problems is therefore not only important but critical to the affairs of the NR industry.

I have attempted to present an overall review of requirements, solutions available, strategies that may be suitable and experiences and lessons learned. The workshop must address itself to the task of fusing all the expertise and experience resident in the ARRPC system and using this to forge a specific programme of action suitable for all the countries not only to effectively modernise the smallholder sector and to expand it, but also to ensure that the smallholder enthusiasm in NR is sustained in the long-term.

Utilisation of Rubber Seeds in India*

V Haridasan Economist, Rubber Board

Introduction

In India rubber is grown mainly in the Southern States with the largest area in Kerala. For a long time only part of the rubber seeds produced in India was utilised. That itself was for raising stock material for budgrafting or seed-lings for planting. Around 1965, small quantities of rubber seeds began to be used for extracting oil. Virudhungar in Tamil Nadu was the centre of that pioneering effort. However the extraction of oil was not widespread or had it acquired the status of an industry. In those days rubber seed oil was used for lighting oil lamps for Sandyavandanami and the rubber seed cake was used as manure. There was some misconception regarding the rubber seed processing at that time. It was thought that rubber seed oil contained some poisonous substances and its processing would pollute the neighbourhood. In fact the municipal authorities had prevented the processing of rubber seed in two towns in South India on that ground. It was Mr. U. N. Dhebar the then that ground. It was Mr. U. N. Dhebar the then chairman of the Khadi and Village Industries Commission of India, who took the initiative for encouraging the processing

In the beginning, the oil millers were sending agents to Kanyakumari district for procuring rubber seeds. Originally the collection of seeds was confined to Kanyakumari district and sussequently it spread to Kerala also. The seeds are now collected from the rubber growing areas in Kerala, Tamil Nadu and Karnataka States. There are a few well established dealers for the purchase and sale of rubber seeds. Most of them deal in rubber also. During the seedfall season, the rubber seed prices are published in leading dailies of Kerala. The rubber seed oil extraction has now acquired the status of an industry.

The increase in the price of non-edible oils and the restriction imposed on imports of goods around the seventies due to foreign exchange shortage, gave a fillip to the industry. The opportunity thus available was also made use of by a few oil millers in Kerala. However the industry is still located mainly in Tamil Nadu and concentrated in and around Virudhunagar.

The millers of Tamil Nadu have a number of advantages in the processing of rubber seed for the extraction of oil. They have been processing groundnut and the mills have been processing groundnut and the mills have been extended that purpose. The groundnut crop of Tan Nadu ill usually arrive at the mills after December while the rubber seed fall season in India is generally between July and September. As a result, it is convenient for groundnut oil millers to process rubber seeds during the slack months. The climatic condition of Tamil Nadu is conducive for drying rubber seeds prior to crushing. During July to September, it rains heavily in the West Cost of India, while there will be hardly any rain in the inland districts of Tamil Nadu. This enables the millers to dry the rubber seeds in the sun. Further, vacant spaces are available to dry rubber seeds in the compound of rice mills of Tamil Nadu during that period. Some of them rent out that facility to oil millers. Yet another important advantage enjoyed by the oil millers of Tamil Nadu over their counterparts in Kerala is in the availability of cheap and plentiful labour for shelling and handling of seeds. These favourable conditions have encouraged the concentration of processing units in that State.

A few units have also come into operation in Kerala State mainly during the last five years as a result of the attractive price available for rubber seed oil. Some of the units have been processing cashew kernal waste and are located in and around Quilon. Table I shows the centres of rubber seed processing in India.

[&]quot;Sandhyavandanam" is a Malayalam word meaning the custom of lighting an oil lamp immediately after sun set as a symbol of God's presence in the home of a Hindu. It has the same meaning in Tamil also.

The paper presented at the Third Seminar and Workshop on Progress and Development of Rubber Smallholders which was held in Cochin 24-30 November 1977 under the auspices of the Association of Natural Rubber Producing Countries (ANRPC).

TABLE 1

Centres of Rubber Seed Processing in India
(1976-77)

	(1976-7	7)
	No. of units	Quantity of dry Kernel Processed (MT)
Tamil Nadu		
Virudhunagar	47	10800
Aruppukottai	5	250
Theni	3	120
Others@	20	500
Kerala		
Quilon	18	200
Pathanapuram	1	75
Punoor	1	100
Others@	2	25
TOTAL	97	12070

@Estimate

Method of Study

In the recent past a number of organisations have shown interest in the availability of rubber seed oil in India. This has prompted the Rubber Board, India, to initiate a study on rubber seed processing. For this purpose, an exploratory study was conducted in the middle of 1976 through the field staff of the Rubber Board stationed in Kerala, Tamil Nadu and Karnataka States. They were required to contact the dealers in rubber seeds in the areas of their operation and to collect the addresses of rubber seed processors. After the preliminary study, a detailed questionnaire was prepared and the author was deputed to the various processing and consuming centres of rubber seed oil in Tamil Nadu and Kerala for collecting details required for the study. The method adopted was direct interview with the millers. For this purpose he visited important centres during the period from December 1976 to June 1977.

Purpose of Study

The purpose of study was to find out the quantity of rubber seed kernel produced in India, the method of processing rubber seed kernel, the trend in the consumption of rubber seed oil and cake and other connected details of the industry. The reference year of the study is 1976-77. It may be mentioned that during the study all the centres of rubber seed processing have been identified. The study has covered about 90% of the identified rubber seed processing units.

Method of Collection of Rubber Seeds

The rubber seeds are usually collected by the children of dependants of workers in the large

estates or the children of small growers. Sometimes collection is entrusted to contractors who may in turn entrust the same with the dependants of workers. In the majority of cases the estate allow the dependants of workers to collect the seeds free of charges.

The rubber seeds are usually purchased by the rubber dealers of the locality. Itinerant dealers have also started collecting the seeds.

Findings of the Study

The data collected from the study are analysed separately for Tamil Nadu and Kerala. This has been done because the cost of production and price realised for the oil and cake etc., are somewhat different in the two States.

Price of Rubber Seeds

From the study it has been found that the materials were purchased as undried seeds, undried kernels or dry kernels. Seeds and undried kernels formed the major portion of the purchase. The millers in Tamil Nadu carried out drying in their factories.

It has been noted during the study that some processors of Kerala had purchased small quantities of dry kernels from Tamil Nadu. Most others in Kerala purchased seeds, then removed the shells and dried the kernels. The prices of seeds and kernels varied slightly. The prices which prevailed in 1976-77 are given in Table 2.

TABLE 2
Prices at which Rubber Seeds were Purchased per Tonne

	TAM	IIL NADU	KERALA		
Type of materials	Minimum Rs.	Maximum Rs.	Minimum Rs.	Maximum Rs.	
Undried seeds	300	500	300	550	
Undried kernels	600	1400	600	1300	
Dry kernels	1250	2050	1300	2100	

Note: The usual prices in both states were:

Undried seeds — Around Rs. 450 per M. T.
Undried kernels — Around Rs. 1000 ,
Dry Kernels — Around Rs. 1500 ,

It can be seen from Table 2 that the prices were not significantly very different in the two states. The prices given above related to those prevailing at the purchasing centre. The millers in Kerala

purchased the seeds from places around their factories. The millers in Tamil Nadu purchased seeds from Tamil Nadu, kerala and Karnataka. Therefore, they had to incur transport charges also. The usual transport charges were between Rs. 50/- to 60/- per tonne. In the case of millers in Kerala, transport charges where not an important item of cost.

Type of Processing

As mentioned earlier, the rubber seed processing was developed as an off shoot of groundnut processing. Therefore, all the units in Tamil Nadu and the majority of units in Kerala were not set up exclusively for rubber seed processing. In Kerala and Tamil Nadu a few units were processing cashew kernel waste also. These units had set up the traditional rotary machinery the investment of which is considerably less and it is easy to operate. The types of machinery used for the processing in Tamil Nadu and Kerala are presented in Table-3.

TABLE 3

Types of Machinery used for processing (1976-77)

(1970-77)					
Rotary Machinery	Expeller				
260	1				
50	1				
310@	2				
	260 50				

Table 3 shows that only 2 units have set up machinery different from the usual rotary type. Excepting one unital others are run on electricity. This unit located in Tamil Nadu, is making use of an oil engine for the purpose.

Duration of Processing

Rubber seed processing is a seasonal operation. It rarely exceeded more than 6 months in a year. In the majority of cases it was about 4 months, Only 2 mills were found to continue the processing through out the year. Of these one was in Tamil Nadu and the other was in Kerala.

Even during the season, the machinery may not be working for 24 hours. In Tamil Nadu, the factory usually worked for about 20 hours. The restriction imposed on the use of electricity was the main reason for the same. In Kerala, the duration of processing was usually 16 hours per day.

Capacity of Machinery

The rotary type of machinery is usually installed as a pair. This is to facilitate full employment

to a worker. Most often the number of solary will be 2 or its miltiple. In Tamil Nadu an average of 250 to 300 kilograms of dry kernel was crushed in one shift by one rotary machine while it was 200 to 250 kilograms in Kerala. The capacity of expeller type of machinery was 3 tonnes per shift in both states. From the study it has been found that the duration of working hours and efficiency of workers were higher in Tamil Nadu than in Kerala. In Tamil Nadu as shift usually consisted of 10 hours as against 8 hours in Kerala. The wages of workers were Rs. 7/- in Tamil Nadu and Rs. 10/- in Kerala per day.

Cost of Processing

The main equipments required for processing are the rotary machine and electric motor. A weighing machine is also used in most mills. For removing the shell, machines had been used only by one mill in Tamil Nadu and 2 in Kerala. In addition, 2 mills in Kerala removed shells partly manually and partly with machinery. If machinery was used the expenditure per tonne of the control of the shell was removed in the case of two drills and was about Rs. 25:- in the case of two drills and was about Rs. 25:- in the case of two drills and was should be Rs. 50;- to look and the usual expenditure would be Rs. 50;- to look and the usual expenditure would be Rs. 50;- to look and the usual expenditure would be Rs. 50;- to look and the usual expenditure would be Rs. 50;- to look and the usual expenditure would be Rs. 50;- to look and the usual expenditure will be an element of loss of kernel. The loss was usually 1 to 2 per cent of the total weight of kernel. This happens because of the chipping off of the rubber kernel during the shell removal operation.

The factories were housed in permanent structures in both states. A few of them were in rented buildings. ANNEXURE shows the cost of processing of rubber seed kernel in Tamil Nadu and Kerala.

There was practically no additional expenditure for drying in Tamil Nadu because of the prolonged dry weather. As a result the cost of drying was negligible. Only the labour charges amounting to Rs. 2/- per tonne would be normally required. However the average cost of drying was Rs. 20/- in Kerala. Two units in Kerala were using klins for the purpose. As a result, their cost of drying was high at Rs. 85 to 100 per M. Tonne.

Loss During Processing

For processing rubber seed kernel, molasses or khandasart² would be required. Usually every 100 kilograms of dry kernel would require 20 to 25 kilograms of molasses. Only a small percentage of molasses was obtained from the Government at controlled rate. The cost was around Rs. 100/= per tonne. The remaining quantity was purchased in the open market, the price of which varied from Rs. 800 to 1000 per M. tonne in both States.

From the study it has been found that the use of molasses was 20 to 25 kilograms in Tamil Nadu, against 25 to 28 kilograms in Kerala. There were a few instances of using a lower quantity of 15 kilograms of molasses in Tamil Nadu. The factories in Kerala were found to use a larger percentage of molasses. In the course of extraction of oil a certain percentage would be lost. This percentage was found to vary from 10 to 15 in both States.

Oil and Cake Recovery

Since a percentage of the total weight will be lost in the processing the recovery of oil also will wary from unit to unit depending upon the quality of kernel, the extent of drying and the quantity of molasses used. Table-4 depicts the percentage of oil and cake recovery in the two States.

TABLE 4
Percentage of Oil and Cake Recovery

		DIL	C	AKE
	Minimum	Maximum	Minimum	Maximum
Tamil Nadu	30%	40%	60%	70%
Kerala	30%	40%	60%	75%

From the table it can be noted that the range of oil recovery was uniform in both states, but there was some variation in the recovery of cake. This was probably due to the larger percentage of molasses used in Kerala.

Price of Oil and Cake

Table 5 gives the variation fin the price of oil during 1975-76 and 1976-77. It can be seen from the table that there was some variation in the price of oil during the two years.

TABLE 5
Price of Oil per tonne

	Year					
	197	1975-76 1976-				
	Minimum Rs.	Maximum Rs.	Minimum Rs.	Maximum Rs.		
Tamil Nadu	3500	5600	3500	5650		
Kerala	3500	6000	3750	6500		

The usual range of prices was between Rs. 4500 and Rs. 5500 in both States during 1976-77. There was no grading in the oil. How-

ever some reputed millers obtained a better price within the range shown above. The price of rubber seed oil is related to the price of similar non-edible oils such as castor oil, neem oil and linseed oil. Oil was generally sold direct by millers to manufacturers of soap and paints. However, a few brokers were also operating in the field. Most of them were Madras based. The prices quoted were ex-factory, freight, insurance and handling charges being charged extra.

The price of rubber seed cake is shown in Table 6. The table shows that the prices were usually higher in Kerala. As in the case of oil, the prices were ex-factory.

TABLE 6
Price of Rubber Seed Cake

	Year				
	1975-76		1976-77		
	Minimum Rs.	Maximum Rs.	Minimum Rs.	Maximum Rs.	
Tamil Nadu	500	1200	500	900	
Kerala	650	1400	550	1150	

The usual range of price in Ke.ala and Tamil Nadu was between Rs. 600 and 800 in 1976-77.

Consumption of Rubber Seed Oil

The study has revealed that the rubber seed oil was by and large used for manufacturing washing soaps. Only a small quantity was used for the manufacture of paints. The rubbber oil used in paint industry is estimated at about 100 M. T. in 1976-77.

The study showed that the main centre of oil consumption was Madurai in Tamil Nadu. Table 7 shows the details.

TABLE 7

Centres of Rubber Seed Oil Consumption in
Tamil Nadu and Kerala

(15/0-/1)					
Quantity (MT)	No. of units manu- facturing soaps				
1000	10				
120	12				
210	27@				
500	25				
50	15				
	Quantity (MT) 1000 120 210 500				

@The Sarvodaya Sangham of Tamil Nadu with its headquarters in Tiruppur has 27 soap manufacturing units located all over Tamil Nadu.

**Estimated

From table 7 it can be seen that 1880 tonites or rubber seed oil was consumed in Tamil Nadu and Kerala. This formed about 50% of the estimated quantity of rubber seed oil produced in India in 1976–77. The above quantity was consumed by the soap industry. Of the 10 units in Madurai, 2 units consumed about 700 M. T. of rubber seed From table 7 it can be seen that 1880 tonnes of

Kerala lags behind in the use of rubber seed oil. Enquries made with soap manufacturers show that the washing soap manufacturers show that the washing soap manufacturer of rubber seed oil is of inferior quality. The largely educated consumers of Kerala require better quality soap. The salme water found in the coastal parts of Kerala during summer also deters the use. Above all the soap manufacturers of Kerala get considerable quantity of mutton tallow at competitive price. These factors have reduced the consumption of rubber-seed oil in Kerala. Kerala lags behind in the use of rubber seed the consumption of rubber seed oil in Kerala.

The paint manufacturing units which consumed rubber seed oil were located outside Kerala and

Consumption of Rubber Seed Cake

As pointed out earlier, rubber seed cake was was some misconception regarding the quality of was some misconception regarding the quality of rubber seed cake as an ingredient of livestock feed. The Kerala Agricultural University examined the contents of the cake on a reference from the livestock and Poultry Feed Manufacturing Company, Malampurba (a company owned by the Government of Kerala) and recommended its use in livestock and poultry feed. The Company is using rubber seed cake upto 10% of the total weight of feed. This company has become one of the leading consumers of rubber seed cake in India. In 1976-77 they had consumed 740 M. T. and they propose to make use of 1500 M. T. during 1977-78. A number of other leading cattle

Total Production of Oil and Cake

On the basis of the study the quantities of oil and cake produced in 1976-77 were estimated at 4200 M. T. and 8000 M. T. respectively. It may however be mentioned that the year 1976-77 was a very good year from the point of view of rubber seed availability. During the year rainfall was not very heavy. This had the following results: (1) incidence of pod rot caused by *Phytophibora* was light and therefore seed fall was far better than in ordinary years. (2) loss of seeds due to deterioration on the ground and storing was less. (3) collection was easy. According to the millers the quantity processed during 1976–77 was almost double that of a normal year.

Benefits of the Industry

The beneficiaries of the industry are the small The beneficiaries of the industry are the small growers and the rubber plantation workers. It has been estimated that 220 seeds can be expected from an ad about 150 seeds can be expected from one tree, if the trees are located in pod rof free areas. If the area is affected by disease, about 75 seeds can be normally expected. Assuming that about 50 seeds are collected, a hectare can provide about 17,500 seeds at a stand of 350 trees per hectare. This is equal to about 30 kilograms. At an average price of 30 Ps this can fetch them about Rs. 24.

It is also possible to develop small scale units for the extraction of oil in the main rubber growing centres. In fact one such unit has been set up in the co-operative sector. The results of the study, it is hoped, can point to the possibility of setting up a few more units in the co-operative

On the basis of the estimated production of rubber seed oil and cake, the industry has added around Rs. 27 million to the national income of Inda in 1976-77.

Acknowledgements

The author is grateful to Prof. K. M. Chandy, Chairman, Rubber Board for permitting him to undertake the study and for giving all facilities. He is also grateful to Mr. P. Mukundan Menon, Rubber Production Commissioner, who has guided him throughout the study and painstakingly examined the paper. The author is thankful to Dr. K. Jayaratman, Assistant Entomologist and Mr. P. U. George, Cost Accounts Officer, for their critical comments and suggestions. The author's sincere thanks are also due to the field staff of the Rubber Production Department and the staff of the Economic Research Division, who have undertaken the preliminary

Cost of Processing in Tamil Nadu

-	(Fer 1000 kg. of dry kerner)	Rs.
I.	MATERIALS COST (including transport) (a) Seeds (b) Molasses	1000 200
II.	LABOUR COST (a) Removing shell (b) Drying (c) Wages	100 2 20
III.	OTHER DIRECT COSTS (a) Electricity (b) Maintenance and Repairs	35

IV. OTHER EXPENSES (a) Supervision (b) Office expenses V. DEPRECIATION (a) Buildings	20 5	II. LABOUR COST (a) Removing shell (b) Drying (c) Wages	160 20 30
(a) Buildings (b) Machinery VI. Interest On Working Capital	10 50	III. OTHER DIRECT COSTS (a) Electricity (b) Maintenance and Repair	40
Total INCOME	1453	IV. OTHER EXPENSES (a) Supervision (b) Office expenses	25
I. Oil (350 kg. at Rs. 5 per kg.) II. CAKE (670 kg. at Rs. 700 per M. T.) III. MISCELLANEOUS RECEIPT (Sale of seed shell of 1 M. T. Rs. 20 per M. T.)	1750 469 20	V. DEPRECIATION (a) Buildings (b) Machinery VI. Interest On Working Capital	5 10 48
Total Receipt	2239	Total	1448
ANNEXURE II Cost of Processing in Kerala (Per 1000 kg. of dry kernel)		INCOME I. Oil (350 kg, at Rs, 5/ kg.)	1750
I. MATERIALS COST (including transport) (a) Seeds	Rs.	II, CAKE (670 kg. cake at Rs. 700/- per M. T.)	469
(b) Molasses	200	Total Receipt	2219

Report of the Research Team for the establishment of a Regional Rubber Research Centre in Tripura

Dr. S. Narayanan Potti, Dr. AON Panikkar and MV Pushpadas Rubber Research Institute of India, Kottayam 686 009

The Rubber Board constituted a research team headed by Dr. S. Narayanan Potti Dy. Director, Agronousyasule of the Rubber Research Institute of India (RRI) to elect a suitable site for the establishment of a Regional Research Centre in Tripura and to make preliminary arrangements for the taking over of the site. The team was also instructed to visit some of the existing plantations in Tripura, este to visit some of the existing plantations in Tripura, the properties of the pro

Other members of the team were Dr. A. O. N. Panikkar (Assistant Anatomist, RRII) and Shri M. V. Pushpadas (Assistant Soil Chemist, RRII) Shri N. Sreekantan Nair, Assistant Development Officer of the Rubber Board, Agartala joined the team

The team visited Chamaknagar, Lambucherra, Bamutia. Salajain and Taránagar. Their impressions on the climatic conditions of Tripura, Meghalaya and Assani's compared to those of the traditional rubber growing tract, problems and prospects of rubber culcivation in Tripura, Meghalaya and Assani's compared to those of the traditional rubber growing tract, problems and prospects of rubber culcivation in Tripura, Meghalaya and Assani's suggestions for improvement of the cotting rubber plantations used are given below:

Champaknagar

The site is located about 25 km away from Agartala, on the side of the Agartala-Assam Road. The area comprises 120 ha. of Government land which consists of a group of small hillocks with flat to gently undulating tops, but running into valleys through very steep slopes. Most of the hillocks will give only less than 2 ha. of contiguous land. This is too inadequate to accommodate field trials, and hence this area is unsuitable for the proposed Research Centre.

Lambucherra

The site is about 10 km. away from Agartala, on the side of the Agartala-Mohanpur Road. On verification with land records at the local revenue office, it was found that only about 15 ha. of Government land are available against the requirement of 80 ha.

Bamutia

This site is about 25 km away from Agartala beyond Gopalnagar Tea Estate, and is very close to Bengladesh border. Poor accessibility makes

the site unsuitable for demonstration purposes and contacts by planters for technical and scientific assistance.

Salbagan

The area is about 8 km away from Agartala. This is suitable for the proposed Research Centre and in the preliminary discussions it was informed that sufficient area would be available. This was therefore, chosen as the first preference, and the Sceretary for Forest, Agriculture, etc., Government of Tripura was informed accordingly. However, during subsequent discussions with Revenue Commissioner and Deputy Collector (Land Records and Settlement), it became clear that this area would not be available for the proposed Centre.

Taranagar

This area is located on the side of Mohanpur road and is about 20 km away from Agartala. Since the other areas visited are unsuitable/ unavailable, and since no other possible sites could be shown to the team, this is the only site

where the proposed Research Centre could be located.

This area consists of flat to gently undulating hand with interspersed 'Lunga' land (low lying paddy land). The Government land suitable for experimental purpose will be \$5.5 ha. while the interspersing lunga' lands (about \$5 ha.) are private enclaves. There are also three bits of 'Tila land (up the proper land will These protection of the contract from the contract the

These aspects were brought to the notice of Secretary for Forest, Agriculture, etc., Government of Tripura, vide letter No. 61/170K/78/RES dated 20-5-1978, and were also discussed in detail with the Revenue Commissioner during the final discussion with him on 23-5-1978.

The entire area of 55.5 ha, was traversed. The land had been cleared about 12 years back and was under 'Jhum' cultivation from time to time which had disturbed the secondary vegetation. The soil is derived from sandstone and is very deep and well drained. At the time of the visit the water table in the upland was sufficiently low to permit satisfactory root growth and in the low land it was within 1.0 to 1.5 metres. From local enquiries and discussions with the officers of the nearby ICAR Complex, it was gathered that the availability of water will not be a problem for the Research Centre. Methods of tapping the water resources will, however, have to be devised in consultation with the local Government Organisations. Electricity was found to be available within easy reach. Availability of labour force also does not appear to pose any problem.

Agroclimatic conditions of Tripura, Meghalaya and Assam as compared to those of the Traditional Rubber Growing Tract

Rainfall

The intensity and pattern of rainfall in the 3 states of North Eastern Region exhibit differences among themselves as well as with those of the main rubber growing tract. Compared to 3026 mm, of rainfall in Kottayam (RRII) that recorded in Tripura is 2363 mm, in Meghalaya 3362 mm, and in Assam 1950 mm. The distribution of rainfall in Tripura is more even as compared to

that of the other two states. The intensity of rainfall in the wettest month is highest in Meghalaya, followed by Kottayam, Tripura and Assam. The highest rainfall is recorded in the month of June in Meghalaya (739 mm) and in July in Kerala (564 mm) and Tripura (476 mm). In Assam, however, both June and July record more or less the same rate (385, 379 mm. respectively). The North East Monssoon is not prominent in the three states in contrast to that in Kottayam. The duration of drought is more in all the three states, compared to that in Kerala. It is maximum in Assam and Meghalaya extending to 4 to 5 months, while it is only about 3 months in Tripura.

Temperature

Unlike in Kerala the three states have a pronounced winter season and, among the three, Assam has the longest winter. The variations in the man monthly minimum temperatures are from 9.4°C to 25.3°C in Tripura, from 10.2°C to 24.1°C in Assam and from 21.2°C to 24.5°C in Kottayam. In general the coldest nights are during January in all the 3 states as well as in Kottayam. However, warmest nights are during January in all the 3 states as well as in Kottayam. However, warmest nights are during August in Tripura and Meghalaya, during July in Assam and during May in Kottayam. The mean monthly maximum temperatures vary from 26.6°C to 33.8°C in Tripura, 23.6°C to 32.5°C in Meghalaya, 19.6°C to 28.0°C in Assam and 28.8°C to 33.9°C in Kottayam. The coolest days are observed during December in Tripura, during January in Meghalaya and Assam and during August in Kottayam. Tripura has the warmest days in March, Meghalaya in April, Assam in September, and Kottayam in March, Meghalaya in April, Assam in September, and Kottayam in March, Meghalaya in April, Assam in September, and Kottayam in March, Meghalaya in April, Assam in September, and Kottayam in March,

Relative Humidity

The data on relative humidity of Meghalaya, Tripura and Kottayam only are available. The relative humidity during all the months is highest in Kottayam and ranges from 77.3 (January) to 92.5% (August). The general pattern of variation in relative humidity during different months follows the same trend in Tripura, and ranges from 72.3 (February) to 85.8% (September). In Meghalaya the relative humidity shows a slightly different pattern of monthly variation and records relatively low values during February to April. The range is from 67.0 (March) to 90% (July).

Soi

In general the soils in the North Eastern region are different from the traditional rubber growing tract. In Tripura the soils are mostly derived from sandstone, sandy to loamy in texture, extremely deep and well-drained, and are generally deficient in major nutrients. However, these soils are likely to respond well to good management

practices. It is reported that in some areas of North Tripura the soils are derived from shale, and it is likely that such soils may pose some problems in management. In general, the soil conditions in Tripura are favourable for Rubber

The potential areas for Rubber cultivation in Meghalaya are hills with moderate to steep slopes which can support Rubber cu tivation on contour which can support ranger or watton or combin-terraces. The soils, mostly derived from gneisses, schists and granites, are loamy to clayey in texture comparatively fertile and are not easily liable to erosion. The depth of soil and its physicoche-mical properties are, in general, favourable for Rubber cultivation.

In Assam also areas available for Rubber cultivation are confined to hills with moderate to steep slopes. The soil conditions are more or less

Problems and Prospects of Rubber Cultivation in the Three States

In Tripura the observations made in the existin Triputa the observations made in the exo-ing plantations indicate that the agroclimatic factors do not have notable adverse effect on the growth of rubber plants. Possibly, one of the reasons for this is that the day temperatures, even during the coldest month, do not go down appre-ciably. However, detailed data are not available for a critical evaluation of the relative growth rates during the different seasons.

In spite of the healthy appearance and satisfactory girthing of mature trees, yield obtained is comparatively very low. One of the factors for the poor yield may be the faulty tapping practices and lack of proper recovery of the crop. Inci-dence of Brownbast is on the high side, and late dripping is also reported, especially during winter season. There is lack of information about the influence of temperature and other meteorological factors, particularly during winter season on the yield pattern of trees. The extent of the influence

Occurence of storms is almost an annual feature in Tripura. This is likely to be a problem, particularly in wind exposed areas. In the existing plantations the real magnitude of wind problem has not been experienced, since they are almost enveloped by forest vegetation which absorb much of the impact of storms. The magnitude There is a lack of information about the flower ing habit of Pueraria in North Eastern region. In this context, it is relevant to note that Mucuna species which is wild in North Eastern region flower and set seeds in that region, but fails to do so in Kerala. Indiscriminate manurial practices adopted, at present, in Tripura may lead to unbalanced nutrition which might affect the yield

and make the plants more susceptible to wind damage. It is reported from Meghalaya and Assam that the trees are not tapped for a period of 6 to 7 months (January to July), because the trees fail to yield latex. This is a problem that needs detailed investigations.

During a visit to the existing nursery immature area in Meghalaya, some of the plants appeared to have been affected by shoot rot disease. Bark diseases were also noticed in mature trees in Assam. Since the meteorological factors, particularly in Meghalaya, are conducive to the incidence of these diseases, the problem needs detailed study for proper confirmation. In this connection it is of interest to note that a species of *Phytophthora*, suspected to be *palmivora*, has been isolated from Tripura at the ICAR Research Complex.

Vertebrate pests such as deer, procupine, wild boar, rodents, etc. are reported to cause damage to nursery and immature plants in all the planta-tions. In Assam, it was observed that white ants attack nursery and immature plants. Grass hopper damage was also observed in nursery.

Peculiar features in agroclimatic conditions like temperature fluctuations, intensity and distribution of rainfall, soil characteristics etc. appear to necessitate suitable modification in the calendar of operations in the nursery and the main field.

Suggestions for Improvement of the Existing Plantations

The number of rounds of weeding carried out in most of the plantations of north eastern region appears to be too inadequate. Considering the appears to be tool madequate. Considering the fact that these plantations are opened in virgin lands and the climatic conditions favour very dense weed growth, at least six rounds of weeding are required during the second year and five rounds in the third year

The effort put in for the establishment of leguminous cover crops in most of the plantations, at present, is not sufficient Pueraria phaseolides should be sown during the year of planting itself.

Discriminatory fertilizer usage based on soil and leaf analysis may be adopted in the existing plantations, especially from the fifth year of plant-

In all the plantations of the North Eastern region the tapping is done by unskilled labourers who either under-exploit the trees or wound them seriously with the result that there is loss of crop as well as damage to the trees. It is necessary to make arrangements for training sufficient number

In some of the plantations there is lack of competent staff to supervise tapping, collection of latex and for maintenance of block-wise yield records which is a routine estate practice

Expert advice from the RRII may be obtained on the processing aspects and the possibility of improving the quality of produce.

Major diseases of rubber like abnormal leaf fall or powdery mildew were not reported/observed from Tripura. However shoot rot incidence in nursery and young plants was observed in Meghalaya in the Umling plantations. In the Kohra plantations belonging to the Soil Conservation Department of Assam, bark diseases were noticed. Since the climatic conditions in Assam and Meghalaya appear to favour the incidence of major diseases of rubber, it is suggested that, in consultation with RRII, appropriate prophylactic measures may be incorporated in the plant protection operations.

It was observed that, in most of the plantations, the choice of planting materials is very narrow (mainly RRIM-600 and GT-1). Since no information is available, at present, on the clonal performance in the North Eastern region where the climatic conditions are different from the conventional rubber growing tracts, it is advisable to plant different planting materials as an insurance against possible failure of certain clones in this region.

In some of the nurseries the seeds for raising the stock seedlings were reported to be available only during the last week of September. As a result of late planting the seedlings attain buddable size only in the second year. There should be assured supply of seeds during the month of August itself, so that the stock seedlings raised from them may be used for budding during the next season itself.

In some of the plantations of APCDC, seed-atstake planting followed by field budding is practised at present. Under the conditions existing in Assam, it is seen that seedlings do not attain buddable size during the next season, and hence there is unnecessary expenditure on the maintenance during the initial years. This practice of planting may be discontinued.

Some of the plantations are carrying out plant ing as late as in September, as a result of which there is high rate of casuality Measures may be taken to complete planting in the proper season itself.

Collaborative Research Studies on Rubber with Assam Agricultural University

The team held preliminary discussions with the representatives of Assam Agricultural University and Assam Plantation Crops Development Corporation regarding the research studies in rubber that could be initiated by AAU research unit for plantation crops, in collaboration with RRII, primarily in the existing plantations of APCDC.

Subsequently the team visited the following Rubber estates.

Burapahar belonging to APCDC.

Rongagora belonging to APCDC. Borgaon belonging to APCDC. Ouguri belonging to APCDC. Kohora Rubber Plantations belong to Assam Soil Conservation Department.

Along with the research team Dr. PC Bora, Professor-in-charge of the research unit for plantation crops of Assam Agricultural University, Shri A. Deka, Assistant Professor, AAU and Shri B. Barua, Divisional Manager, APCDC participated in the field visits and discussions. The research team identified the following research programmes to be started during 1978 and 1979;—

Fertilizer trial

The physico-chemical properties of soil in Assam, particularly the pH and soil temperature, are likely to alter the response to different sources of phosphorus that is observed in the traditional rubber growing tract, and as such it is desirable to have a trial on forms of phosphate. This may be initiated in 1978–79 at Burapahar and Ouguri Rubber estates.

Weedicide trial

In all the existing immature rubber plantations heavy infestation of weeds particularly 'Lalang' was noticed. Proper control of these weeds is necessary for the successful establishment of cover crops and satisfactory growth of rubber plants. It was therefore proposed to start a weedicide trial at Burapahar and Borgaon rubber estates during 1978–79.

Clone trial

Information on the performance of different clones under the agroclimatic conditions prevailing in Assam is not available. Since large areas are likely to come under rubber plantations in future it is necessary to commence an experiment in this line.

Studies on the Yield Pattern of Rubber Trees During Different Months

Under the local conditions of Assam the data on the yield pattern of mature trees in the different months of the year are not available. It is therefore worthwhile to utilise about 30 to 40 mature rubber trees in the existing Kohora Rubber Plantations belonging to the Soil Conservation Departations ment for collecting these data. To facilitate this study, some skilled tappers are necessary. It was, therefore, suggested that the Managing Director. APCDC may request the Rubber Board to depute one Tapping Demonstrator for about 6 weeks to ment and APCDC in scientific methods of tapping. AAU could also take advantage of this training programme by sending one or two of its employees. In a final round of discussions with Shri R. Barua, Managing Director, APCDC the team emphasised the imperative need for research support for the plantation development program-mes of the APCDC. Shri Barua offered all co-

Intensive Rubber

Objective

The 10 day country-wide Intensive Rubber Production Drive Taunched by the Rubber Board from 22nd to 31st October, 1978 ended as sche-duled, with an optimistic note of determination on the part of the rubber planting community to strive the part of the rubber planting community to strive hard to boost up indigenous output of natural rubber by immediate adoption of appropriate technology. Unlike other perennial crops, rubber can be made to respond to short-term yield-pro-moting techniques like chemical stimulation of during monsoons, perfecting the systems of tap ping, regular replenishment of the soil and crop

The drive for boosting rubber production was necessitated on account of the sharp decline in rubber production caused by the unprecedented and prolonged monsoon during May to August this year. The loss of crop suffered due to this hazard is estimated at 19,000 tonnes. A review of the production of natural rubber during May to August this year, compared to that of the corresponding period last year, would testify the position.

Production (Tonnes)

Month	1977	1978	Less by	
April	11074	8366	2708	
May	12523	11130	1393	
June	12980	7615	5365	
July	10266	7150	3116	
August	12526	6130	6396	

the corresponding period this year, had gone up by around 6,000 tonnes making the total deficit during these five months alone to 25,000 tonnes.

Seven Point Programme

Unless concerted efforts were made on a warfooting to make good the loss so suffered, the Board felt, the days ahead would be too hard for the rubber industry. The other objectives of this drive, apart from compensating the loss in pro-

- (a) even out production of rubber round the year so as to ensure uniformity in supply
- (b) rate of growth of rubber production to be kept on a par with that of consumption,

A short account of the recent campaign launched by the Rubber Board to boost domestic rubber production

- (c) to maximise output from unit area, (d) attain self sufficiency and do away with
- (e) finally upgrading the technology employed by small holders.

To achieve these objectives a 7-point Rubber Production Plan, which ensured ease in adoption and immediate increase in yield was chalked out in consultation with the R & D personnel of the Board for dissemination among the rubber growers, especially the small holders' sector. The plan of action suggested under the seven point programme

- (1) Apply 'Ethrel' for stimulating rubber yield.
- (2) Judicious application of fertiliser during October-November and next April-May.
- (3) Open all rubber trees which have attained tappable girth.
- (4) Tap at correct depth and slope.
- (5) In areas where alternate daily system of tapping is followed, tap the trees one more day additionally in a week.
- (6) Rainguard rubber trees under tapping, so that they can be tapped during rainy months
- (7) Strictly adhere to plant protection measures.

The strategy devised by the Board for popularising the new techniques designed for increasing rubber production among the prospective adopters was interpersonal communication, as it was found to be the most effective medium that would carry conviction to the grower in the remote village. To achieve this over 130 group meetings of rubber growers were organised throughout the length and breadth of the rubber producing belt in the country and the 7-point programme were explained to them by the Board's personnel in all its detail. In addition, method demonstrations of application of yield stimulant, rain guarding of rubber trees and correct tapping methods to be adopted were performed at these meetings for the participants to

Enthusiastic response

Altogether over 11,000 small growers of rubber had enthusiastically responded to the Board's invitation to participate in these meetings and attended to the deliberations and demonstration in 130 centres. The invitation to the prospective participants were issued in the form of personal letters signed by the Chief of the Rubber Board wherein the 7-point production plan had been spelt out. Such letters were addressed to 50,000 small growers.

Given below is an account of the quantum of participation of rubber growers in the group meetings zone-wise.

Zone	No. of meetings held	No. of participants
Kanyakumari	3	225
Trivandrum	6	350
Punalur	10	750
Pathanamthitta	1 12	820
Kanjirappally	9	750
Kottayam	16	1400
Palai	19	2500
Thodupuzha	8	50)
Moovattupuzh	a 10	725
Ernakulam	10	670
Trichur	4	400
Palghat	5	300
Calicut	8	675
Taliparamba	11	940
		11005

The average turn out per centre was 85.

In addition, to ensure the involvement of large estates in the attempt for maximising rubber production, a meeting of the major constituents of the Association of Planters of Kerala was convened by the Rubber Board on 14th October at Cochin and were briefed of the intensive production plan. The participants had assured their cooperation for the programme and consented to associate with the Board in popularising the new techniques among the small holders of their respective area.

Board's participation

The entire machinery of the Board was grared and directed to take care of the organisation of the campaign. The personnel of the Board entrusted with the campaign job were given exhaustive training on the strategy to be employed for organising the meeting, guiding the deliberations and performing the method demonstrations. A special 8-page supplement of the Board's Malayalam magazine 'Rubber' was brought out, highlighting the salient features of the 7-point Plan and distributed free to all the participants. As a result of the special arrangements made at each meeting, over 2500 growers were enrolled as new subscribers to this magazine.

When the Intensive production Plan was thrown open to the growers for discussion at these meetings, they had pleaded for enforcing a stable and remunerative price for their produce. They had

also asked for incentives for adoption of rain guarding and other estate operations suggested in the programme. Buffer stocking of rubber is another demand raised by the growers.

Several organisations like the Planters' Associations, Small holders' organisations Voluntary organisations like the Kerala Sasthra Sahitrya Parishath, Cooperatives of rubber growers, Youth organisations, Plantation service firms, the Kerala State Cooperative Marketing Federation, the Church etc. had very actively associated with the Board in organising this campaign. Rubber beard members, Peoples' representatives of the respective areas and Leaders of growers also had extended their patronage for the promotion of the campaign. The then Kerala Minister for Agriculture, Shri. K. Sankaranaranyanan had issued a special message appealing rubber growers to rally round the Board in this task.

Some of these organisations had erected banners, printed special invitations for the occasion, served light refreshments to the participants, made special reports in newspapers and over radio.

Adequate Coverage

The mass media had given adequate coverage for the drive including editorial support by leading newspapers. Special broadcasts were put on the air by the All India Radio on all days of the campaign highlighting the 7-point Plan and also announcing the centres fixed for rubber growers'

The drive caught up well and was devoid of all pomp and show that go with such events. To that extent the production drive marked the beginning of a silent revolution. The fraternal informality that prevailed throughout, was in fact the unique feature which facilitated intimate interpresonnel interaction between the Board and its clientele during this campaign.

Arising from the campaign

The general complaint voiced by the small growers, when the method demonstrations were held before them, was that for want of adequate skill and know-how with the tappers employed by them the system of tapping followed in small holdings was defective resulting in heavy loss of crop. They had sought the intervention of the Board for rectifying the defects in the present system by organising an educational campaign for the tappers engaged by small holders. This proposition appeared sound. Therefore the Board has decided to organise a training programme for tappers shortly.



Shri P. Mukundan Menon explaining how to rainguard the rubber trees. Extreme left is Shri S. G. Sundaram I. A. S., Chairman Rubber Board.



Rubber growers who participated in the Seminar held at Amboori in Neyyattinkara Taluk

Follow-up of the Drive

The intensive rubber production campaign is proposed to be followed up by:—

- (1) Posters on the 7-Point Plan.
- (2) Repeated broadcasts over radio at periodical intervels on the techniques included in the programme.
- (3) Articles on the 7-Point Plan in 'farm feature's 'in leading newspapers.
- (4) Holding one-day Seminars in important rubber growing centres.
- (5) Organising the supply and services required for rain guarding, yield stimulation etc. at reasonable prices at the right time and place.
- (6) Incentives for rain guarding.
- (7) Training for rubber tappers employed by small holders.

-PK NARAYANAN



The Growers assembled at Alakode

A Rubber Plantation for Repatriates

An area of 5,200 acres (2,100 hectares) has been brought under rubber at Ayiranelloorand Kulathupuzha Forest Reserves by the Rehabilitation Plantations Limited, Pundlur, a Public Sector Rubber Plantation Enterprise, functioning under the Ministry of Rehabilitation of the Government of Kerala. This enterprise which commenced planting of rubber's plansed manner under the Kerala Forest Department on an extensive scale as early as 1972 with a view to rehabilitating a portion of the area of the provided planting of rubber's partial from Sri Lanka as per the Srimavo—Sashiri Agreement of 1964, was after converted to a public sector undertaking in 1976 with an authorised capital of Rs. 47-crores. Disclosing this to the Rubber Board, Shri. G. Moni, Managing Director of the Rehabilitation Plantations limited, revealed that so far 346 amilies from Sri Lanka have been housed in this plantation. This would be doubled, be said.

The materials used for planting in this plantation are the high yielding clones like RRIM-600, 605, GT-1, PB 5/51, PR 107 and RRII-105. The entire technical know-how for raising this plantation has been imparted by the Rubber Board.

Being the best Rubber Plantation in the country, it is attracting large number of prospective entreprenures from other states who may emulate this example.

When opened for tapping it is expected that this plantation would yield anything between 1600 to 2000 Kg per hectare which is more than double the national average. This plantation is estimated to produce over 5,000 tonnes a year when the entire 5200 acres are opened for tapping. The cost of cultivation per hectare for bringing up the rubber plants to the level of maturity in this plantation has come to only Rs. 13,5000,—assaginst the standardised cost of Rs. 15,000,—per hectare.

Of the 4.7 crores of rupees earmarked as authorised capital 2.25 crores would be equally shared by the Governments of India and Kerala while the rest would be loaned from the Agricultural Refinance and Development Corporation.

The whole idea of this enterprise was conceived and put into operation by Shri. K. K. Nair, Chief Conservator of Forests of Kerala ably assisted by a dedicated team of Senior Forest Officials.



A Rubber Study Group from the North Eastern Council visited the Rehabilitation Plantations Ltd., Punalur. They witnessed the growth of a tree which attained a girth of 16° in four years



Cocoa as an Intercrop

Cocoa could be cultivated as an intercrop in rubber plantations according to the UN Spices Expert Dr. K. V. Ahamed Bavappa. This was done in Sri Lanka he said.

Cocoa cultivation in rubber estates was taken up in Sri Lanka not as a commercial proposition but to protect the rubber trees from excessive heat. Later as the price of cocoa increased, the farmers began cocoa cultivation on a large scale.

The only change made in Sri Lanka to facilitate inter cropping was to increase the space between rubber trees. Dr. Bavappa informed that about 5000 acres in Sri Lanka had cocoa cultivation.

Tyre price to be reduced

a The All India Motor Transport Congress made a representation to Union Industry and Transport ministers demanding the lowering of tyre prices or the introduction of a statutory regulation of prices and distribution. The Congress pointed out that after hiking tyre prices by 10 to 12 percent, manufacturers again jacked up the prices by almost 40 percent recently. This has badly affected the work of many transport operators.

As tyres constituted a major part of the operating costs of trucks, a steep increase in their prices was unbearable, Congress sources said. It is estimated that 85 per cent of the transport operators have one or two vehicles.

Reaction of the Manufacturers

A spokesman of the tyre manufacturing industry on the other hand said they had no control over tyre prices since there had been a steady rise in the prices of various raw materials used in the

industry. He said that some raw materials like rayon chords were not available in the country at fixed prices.

In the event of non-availability or short supply of raw materials tyre companies were forced to reschedule their production programme. However, there was neither a cut in production nor shortage of tyres in the country.

Sri Lanka to boost rubber production

Sri Lanka intends to boost rubber production, reports Economic Times. They intend to raise rubber production to about 17,000 tonnes by 1983 as part of a long term plan to develop its rubber industry. The plan to be spread over 15 years, includes a replanting target of 3 per cent of the area under rubber or 15,000 acres a year. The target is to be gradually stepped upto 5 percent to catch with a big replanting backlog over the past few years.

The plan will be implemented with assistance from developed countries and a three-member team from the UK ministry of overseas development is already advising the Government on increasing production and improving process techniques.

NR Consumption Exceeds Production

World stockpiles of NR will shrink by 75,000 tonnes in 1978, according to Firestone Tyre and Rubber analysts. If the prediction holds up, it will mark the fifth consecutive year in which was consumption has outstripped production. Dwinding world stockpiles of NR will be called on fill the gap between 3,225,000 tonnes and 3,750,000 tonnes of production. Increasing usage of NR in radial tyres, plus expansion of its traditional markets in truck and off-the-road tyres are given as the reasons for the NR shortfall.

Quality Problems

There is continued talk of tyre firms changing their NR grade for radial tyre usage away from the Technically Specified Rubbers (TSR), for the higher sheet grades because of rumoured quality problems with such grades at TSR 20. Prices for TSRs were down during July, while New York spot prices for No. 1 RSS climbed from 45½ to 47 cents per pound during the month.

Ethephon: Plant growth regulator

The following note on 'Ethephon' is reproduced from Science Reporter-Oct. 1978.

Ethephon is an important plant growth regulator. By its application, rubber latex yields can

be increased by 200% to 300%. Ethephon charges the female-male flower ratio and this eventually yields more fruits in many plants. It is also used for maturing and ripening of fruits in a number of plants, and it is reported to increase yields of certain cereals. Ethephon is not known to be produced in India. Also, its requirements in the country are not known precisely. Formulations of Ethephon, imported from Amchem of USA, are marketed under the brand name "Ethrel" by Agromore Ltd., Bangalore. The requirements for latex stimulant formulations have been estimated at about 1.5 tonnes/annum by the Rubber Research Institute (RRI), Kottayam. The requirements of various plant growth regulators, as estimated by the Directorate of Plant Protection, Quarantine and Storage, is

The National Chemical Laboratory (NCL), Poona, has developed a process for the manufacture of Ethephon, with a view to make the country self-sufficient. The process consists in (i) preparing triss-(2-olitoreethy) phosphite from phosphorus trichloride and ethylene oxide; (ii) isomerization of the phosphute to the diester of phosphonic acid; and (iii) de-esterification of the diester of phosphonic acid by dry hydrochloric acid gas to yield Ethephon.

Experiments

The process has been standardized on 5 litres per batch scale. Yield of Ethephon is about 90% based on phosphorus trichloride. The product has been tested in the laboratory as latex stimulant by RRI Kottayam, and has been found to be satisfactory. The Nimbkar Agricultural Research Institute, Phallan, has also tested the product successfully for cucumbers and is carrying out experiments on some more plants.

Phosphorus trichloride, ethylene oxide, hydrochloric acid and sulphuric acid are the main raw materials required, and these are available indigenously.

Flasks, stirrers, distillation condensers, bubblers (all-glass), electrically heated oil-baths or heating mantles with controls, and chilling unit are the major items of plant and equipment. These are either available indigenously or can be fabricated.

The capital outlay for a plant of 6 tonney annum capacity (considered economical by NCL) has been estimated at Rs. 2.46 lakh (Rs. 1.06 lakh on land, and Rs. 0.96 lakh as working capital). The cost of production is estimated at Rs. 51.5 per kg against the C. I. F. price of Rs. 200 per kg for the imported material. The selling price of 10% solution of Ethrel, used as latex stimulant, is Rs. 105 per litre while that of 40% solution of Ethrel, used as plant growth regulator, is Rs. 350 per litre while that of 40% solution fig. 18 is 350 per litre while that of 40% solution fig. 18 is 350 per litre while that of 40% solution fig. 18 is 350 per litre while that of 40% solution fig. 18 is 350 per litre while that of 40% solution fig. 18 is 350 per litre while that of 40% solution fig. 18 is 350 per litre while that of 40% solution fig. 18 is 350 per litre while the solution fig. 18 is 350 per lit



Rubber Growers' Interest to be Protected

Mr. Krishna Kumar Goyal, Hon'ble Union Minister of State for Commerce, Civil supplies and Co-operation categorically assured the rubber growers that their interest would be the main

consideration in any decision the Government might take about rubber. He announced that the Union Government would shortly convene a conference of rubber growers, manufacturers and



The civic reception at Palai



Arrival at the Rubber Research Institute of India. Shri VK Bhaskaran Nair garlanded the Minister and Shri V Bhaskara Pillai presented the bouquet



Shri SG Sundaram IAS Chairman Rubber Board welcomed the chief guest

other interests of the industry to discuss the problems faced by the rubber plantation industry.

He was replying to a civie reception accorded to him by the Municipal Council of Palai on December 10th 1978. The Minister said that the Government and the Rubber Board would give all assistance to the rubber producers in the council of the Government was that the rubber growers should be given all incentives besides sating a reasonable price to make them self sufficient and to produce more and create a situation whereby India would be able to export rubber. Mr. Goyal refuted the charge that the Union Government was accumbing to 'pressures' from certain quarters. 'The Government is not subject to anybody's pressure' he said. The decisions were taken only on the basis of certain basic principles and objectives.

Rubber Import

He said that the centre had imported 15,000 tonnes of rubber only because there was shortage in the internal market. Before deciding on the import, the centre had asked the State Government to make available the rubber required by the industry, but the State could not do it, he added.

Shri Thomas Joseph Kottukappilly, Palai Municipal Chairman, read the civic address and presented the same to the Minister enclosed in a sandal-wood casket. Rr. Rev. Sebastian Vayalil, Bishop of Palai presided over the meeting. Those

who addressed on the occasion included Shri S. G. Sundaram IAS, Chairman Rubber Board, Shri T. P. Seetharaman, Vice Chairman, Rubber Board, Shri George Mathew M. P. and Shri Joseph Monipally, Mr. T. A. Thomane proposed a vote of thanks. Mr. Joseph Monipally General Secretary of the All India Rubber Growers Association presented a negonitary of the Company of the All India Rubber Growers Association presented and processing of the trubber growers. Later to witness tapping of the rubber tree and processing of rubber latex, the Minister also visited a small holdings at Palai.

The memorandum submitted to the Minister urged the centre to stop imports of natural rubber as it would adversely affect the rubber producers of Kerala.

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Visit to the Rubber Research Institute

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Board Meeting

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The Board accepted the recommendations of the committee and decided to review the demand and supply position early next year and make appropriate recommendations to Government.

Sethuraj Awarded Ph. D.

Shri M. R. Sethuraj, Plant Physiologist of the Rubber Research Institute of India has been awarded a Doctorate Degree by the Benaras Hindu University for his dessertation entitled "Studies on the physiological factors influencing





Arrival at the Rubber Research Institute of India, Shri VK Bhaskaran Nair garlanded the Minister and Shri V Bhaskara Pillai presented the bouquet



Shri SG Sundaram IAS Chairman Rubber Board welcomed the chief guest

other interests of the industry to discuss the problems faced by the rubber plantation industry.

He was replying to a civic reception accorded to him by the Municipal Council of Palai on December 10th 1978. The Minister said that the Government and the Rubber Board would give all assistance to the rubber produce in the country. The policy of the Government was that the rubber growers should be given all assistance to the rubber produce the rubber growers should be given at reactive besides assuring a reasonable price to make them self-sufficient and to produce more and self-sufficient and to produce more and assistantion whereby India would be able to expenditude the sufficient of the sufficien

Rubber Import

He said that the centre had imported 15,000 tonnes of rubber only because there was shortage in the internal market. Before deciding on the import, the centre had asked the State Government to make available the rubber required by the industry, but the State could not do it, he added.

Shri Thomas Joseph Kottukappilly, Palai Municipal Chairman, read the civic address and presented the same to the Minister enclosed in a sandal-wood casket. Rr. Rev. Sebastian Vayalil, Bishop of Palai presided over the meeting. Those who addressed on the occasion included Shri S. G. Sundaram IAS, Chairman Rubber Board, Shri T. P. Seetharaman, Vice Chairman, Rubber Board, Shri T. P. Seetharaman, Vice Chairman, Rubber Board, Shri George Mathew M. P. and Shri Joseph Monipally Mr. T. A. Thommen proposed a vote of thanks. Mr. Joseph Monipally General Secretary of the All India Rubber Growers' Association presented a memorandum to the Minister highlighting the problems of the rubber growers. Later to witness tapping of the rubber growers. Later to witness tapping of the rubber trees and processine of rubber latex the Minister. tree and processing of rubber latex, the Minister also visited a small holdings at Palai.

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Das Joins North Eastern Council

Shri M. G. Jagadish Das has taken over as Rubber adviser to the North Eastern Council. Shillong. He was Deputy Rubber Production Commissioner in the Rubber Board till he took up the new assignment. The appointment is for a period of one year.

Parasuraman Appointed Deputy R. P. C.

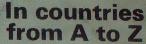
Shri V. Parasuraman, Dy. Development Officer, has been promoted as Deputy Rubber Production Commissioner. He joined the new post on 20th November 1978.







Shri Goyal meeting the Board Members at the Board's guest house







reclaim rubber importers have faith in IRRCO

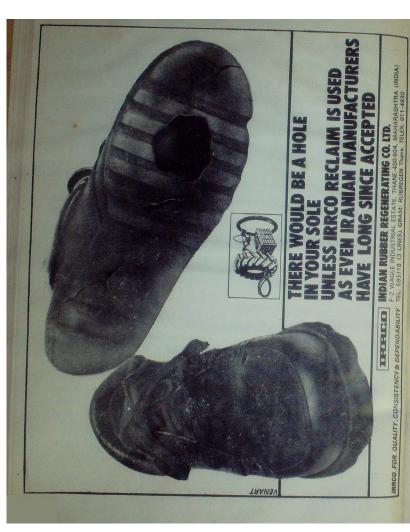
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* Cumulative upto 31st March, 1977



SULLECIN



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Director of Research : VK Bhaskaran Nair

Rubber Production Commissioner : P Mukundan Menon

Project Officer : CM George

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All enquiries to be addressed to: The Editor, Rubber Board Bulletin, Kottayam 686 001, India, and payments to be made in favour of: The Secretary, Rubber Board, Kottayam 686 001, India. The year 1977 marked the contenary of the introduction of the Para rubber tree into Singapore. The Rubber Centenary Committee appointed for the overall celebrations has brought out a commencration volume which includes the content of the content of the content of the content of the carry days to the content of the carry days to the content of the co

nestype pansforthefuture

Tan Shri Dr BC Sekhar

This is the 100th year of the arrival of a few Herea seedlings into Singapore. It is from this nuclear material that Malaysia has developed to become the world's largest exporter of natural rubber (NR), accounting for nearly 44 per cent of the world's supply. It is, therefore, only appropriate on this centenary occasion that 1 not only convey to you in Singapore the felicitations and good wishes of Malaysia and the Malaysian NR industry but also extend to you our sincere thanks for that initiating act of generosity and co-operation you gave us one hundred years ago.

We have arrived at the current natural rubber situation through many trials and tribulations, failures and achievements, oscillating attitudes and confidence, external pressures and internal doubts, economic turmoil and commodity market vagaries. Through these vicissitudes over a hundred years of development history, we have enriched our knowledge, experience and capacity. We are compelled now to look at the future with this historical prespective, and it is imperative that we must strive forward with vision, dynamism and confidence developed through our unique success. It is in this context that I would like, in this paper, to make a fast scan of the historical factors concerned with NR production wis-a-wis SR (synthetic rubber), with the evolution of total elastomer consumption and with NR research achievements, before arriving at what I see as the future plans for natural rubber.

Natural Rubber

In the context of the present-day world, which is beset with political, social and economic up-heavals, it is comforting to look back a hundred years, when the spirit of international eco-peration and the consequent transfer of technology sowed the seeds of the NR industry in Southeast Asia. The early history of the industry was characterized by international participation and the division of babour, although its development was inevitably stimulated by the profit motive through the so-celled 'invisible and of latiese-faire economiese. With the combination of factors like the indigenous supply of land resource, capital financing from the West, plentiful labour from South India and China and managerial expertise especially from the UK and Holland, the foundation for the rubber industry was firmly laid. With increasing demand, especially following the development of the pneumatic tye, its future take-off-was never in doubt.

The early attempts at developing the rubber industry on a large scale rested almost entirely with the private sector. There was little or no co-rdination and integrated planning both within and among the major producing countries. To a large extent, the "free-for-all" state of competition often resulted in periodic supply/demand imbalances leading to undesirable private functions and their concomitant effects on the



Tan Shri Dr. B. C. Sekhar

short-term market forces were allowed to dictate the destiny of the industry. This feature was repeatedly evident in the various phases in the economic development of the industry. During the 1908—1920s, the period often referred to as the era of expansion, the rapid conversion from wild rubber to plantation rubber was achieved principally at the expense of other tropical crops such as coffee and gambir; the arrival of the automobile boom, which escalated the prices of NR, provided an added fillip. These were followed by the era of consolidation in the 1920s—1940s, which witnessed for the first time problems of oversupply and associated price fluctuations. This problem became so serious that it soon led to some form of international agreement to co-ordinate and regulate the supply. First, the Stevenson Scheme was introduced during 1922—1928 in the then Mislaya and Ceylon (now Sri Lanka) with the main objective of controlling exports. The termination of the Scheme coincided with the world depression, and the prospect was so grim that NR producers had to look for a different approach to slove the crisis. The outcome was the International Rubber Regulation Agreement enforced during 1934—1940, which was more comprehensive, in that it covered all producing countries.

At the time this agreement was introduced, the NR industry was free of any real threat from synthetic substitutes. However, the need for restriction and the imposition of such restrictions did certain irreparable harm to the development of the NR industry. It suffered a further setback following the occupation of Southeast Asia by Japan during the war, when very little was done to maintain the health and vitality of the industry.

With the termination of the second world war, the NR industry began to face intense competition from synthetic rubber—a commercial product synthesized out of strategic necessity during the war period. Based on cheap supplies of petrochemical feedstocks and the benefits of the economy of scale enjoyed by synthetic plants, this threat of SR assumed great importance. Faced with such competitive problems, threatening the very existence of the NR industry, and the aggressive posture assumed by the synthetic rubber sector, the NR industry in Southeast Asia began to modernize and discipline itself through R and D efforts. Thus 1950, with the implementation of a large-scale replanting programme, marked the turning point in the NR industry.

Synthetic Rubber

By contrast, the SR industry, owing to the forces of circumstance, assumed an entirely different approach to its production and development. The birth of the industry was principally prompted by political and strategic considerations, especially in relation to the security of surplies. Fully backed by massive public sector and multi-national corporation resources, the industry was organized on a gigantic scale to exploit economies of scale, cheap petroleum feedstocks, and the existence of earlier markets.

It was the cut-off of the supply line from Southeast Asia during the second world war that provided the real impetus for the development of SR industry. Concurrently, however, the perfection of the techniques of emulsion polymerization, stereo-regular polymerization and the availability of a wide range of suitable monomers have provided the technical thrust in making commercial-scale production possible for a variety of general and special purpose synthetic rubber, plastics and

From the 1950 onwards, the expansion in the output of SR was phenomenal. Induced by the Korean War boom with associated high prices on the one hand, and several technical breakthroughs on the other, the SR industry became more firmly entrenched and began seriously to challenge the market share of NR.

The period also saw the development of second generation synthetics, such as polyisoprene (IR), polybutadiene (BR) and ethylene/propylene co-polymer (EPM), which were tailor-made for specific enduses. This development increased the versatility of SR, thereby further strengthening its threat to NR in the world market.

Perhaps what had given strength to the SR industry was the full support and backing received from the industrialized countries. The industry was planned with the priority objective of meeting the needs of these industrialized countries, although

the initial need was largely political in nature. Forthermore, the capital intensive nature of the industry necessitated the formation of multinational corporations to manage and operate the SR plants, through which the industry was able to enjoy captive markets, economies of scale and massive R and D programmes.

The primary strength of the SR indu try revoleed round the availability of abundant supplies of petro-chemical feedstocks at very low prices. With the polymer boom immediately after the war, with new polymerization techniques and new monemers being discovered and developed in universities and industrial laboratories, it became the trend for the synthetic sector to challenge the very existence of the biologically-based polymers. The SR industry miscalculated its ability to provide chesper substitutes in abundant quantities, always assuming that the price of petroleum would remain low and its supplies inexhaustible.

Total Elastomer Consumption

Very few industries have indeed displayed as fast a growth as the elastomer industry. As essential raw materials in industrial production, both NR and SR have enjoyed increasing demand in line with global economic and population growth. Historically, world demand for both NR and SR approximately doubled itself every decade, as can be seen from Table 1. The NR sector, however, was unable to expand as fast as it should, resulting in definite shortfalls in supply which had to be filled by SR. For example, while the total demand for rubbers has grown at an annual rate of 7 per cent since 1954. NR supply has increased by only 2 per cent. The NR supply was necessarily limited by a number of basic factors, the principal ones being the absence of a dynamic production palicy, the inherent inelasticity of a perenial crop and the built-in conservative and pessimistic planting policy. SR, on the other hand, was able to exploit to the maximum the cheap and apparently abundant petroleum feedstocks as well as the economics of scale in the context of a growing market. Consequently, the market share of NR deelined from virtually 100 per cent before the second world war to the current level of 32-33 per cent.

Apart from supply inhibition, the volatility of the NR market and associated trading features have tended to prevent the maximum utilization of NR. It is a well-known fact that when NR prices are high, consumers tend to switch to SR. On the other hand, when NR prices decline, the switch back is not automatic for fear of causing a price hike. Thus, NR suffers on both counts are sufficiently of the producers. It is not according to the producers.



Young high-vielding clon

TABLE 1

Consumption and Market Share of NR

Year	Total world rubber con- sumption (000 tonnes)	NR consumption (000 tonnes)	NR share of the market
1900	53	53	100
1910	102	102	100
1920	302	302	100
1930	722	722	100
1940	1,127	1,127	100
1950	2.339	1.750	75
1960	4 400*	2,095	48
1970	8,600*	2,992	35

FAO estimates including SR consumed in centrally planned countries.

Petroleum Situation

The OPEC countries initiative in reviewing the petroleum situation, especially in respect of the cost and availability of this non renewable resource, and the price-hise therefrom shocked the world into the realization that there is need to review global attitudes towards resource conservation, energy requirements and environmental pollution. No doubt, the damaging effects of the

increased petroleum prices to the economies of consuming countries in its turn, had impinged on the market for natural rubber. However, with the more realistic price of feedstocks for synthetic rubber, the techno-economie strength of natural rubber has been placed completely outside the reach of any competing synthetic substitutes.

Obviously, the advent of such an energy/material crisis, coupled with the global concern with environmental pollution, adds force to the general proposition that the world is moving from a petro-chemical era to a "biological products cra"; of more specifically, in our context, the matural rubber era". The contrast between natural rubber, a renewable material produced by an essentially non-polluting industry, and the synthetic elastomers made from scarce and now exceedingly expensive feedstocks is therefore obvious. I will not daborate on it. Suffice it to point out that economic power has in fact tilted the situation well in favour of natural materials. In the 1950s and the 1960s, synthetic rubbers had to fill the gap through volume production based cheap facetstocks from oil because of the inability of natural rubber to satisfy world rubber demand; advantage was also taken of economics of scale arising from bigger plants. The U-shaped cost function so often talked about by economists in the context of scale economics has finally bottomed; the costs of plant have escalated and the excessive capital required have become inhibiting. Natural rubber, therefore, is no longer faced with a one-sided competition. This may be gleaned from the 1967/1974 feedstocks costs for synthetic rubbers shown in Table 2.

TABLE 2

Prices of feedstocks and monomers
1967 and 1974

	US\$ per tonne		% increase			
Feedstock	1967	1974	in price			
Naphtha	30	130	550			
Benzene	74	500	576			
Butadiene	185	385	108			
Styrene	180	800	344			
Isoprene	275	660	140			

This situation is not simply a feature of the energy shortage or crisis. There is talk today of a further upward adjustment in petroleum prices in keeping with inflation. In spite of new discoveries and off-shore exploitation, petroleum is an exhaustible resource within any reasonable time scale. After all, it is sunlight energy absorbed through plants and mammals which then decay and end up as petroleum in a timespan of millions of years. This petroleum is the current source of petro-chemicals leading to the production of synthetic rubbers. In contrast, the Hevea tree

photosynthetically converts sunlight energy into natural rubber everyday.

One fundamental requirement in today's context is the need for us, both from the NR and SR sectors, to move into a position of complementation. The key point that we must all appreciate is that while the world cannot do without natural rubber, neither can it do without synthetic rubber. This realization has prompted the two industries to shift from the bitter aggression of the 1950s to the co-existence of the 1960s and, hopefully, to complementation in the 1970s. The energy crisis has dramatically introduced new dimensions into the role of natural rubber vis-a-vis synthetic rubber in satisfying the prowing world demands for all elastomers. With and eye to the need of future generations, it is impressive that more careful, optimal use of resources is called for by way of effective conservation programmes. A new type of approach between the SR and NR is required felective conservation programmes. A new type of approach between the SR and NR is required between the provide such such as a such a

The Small-Man Industry

In the light of the above, it is important for us to appreciate the structure of the NR industry in Southeast Asia. The industry is characterized by the direct involvement of small-holders who own the direct involvement of small-holders who own and cultivate some 67 per cent of the total planted areas in Malaysia, 78 per cent in Indonesia, and 95 per cent in Thailand. This feature is particularly important, since it has great socio-economic bearings on the region's prosperity and development. Most of the small holdings are less than 5 hectares apiece and are widely scattered. While there are organized public-sector land development schemes and co-operative activities, the major proportion of the small-holder sector remains in the hands of scattered individuals. It is because natural rubber is capable of growing under very diverse soil conditions, on difficult terrain and not overly sensitive to management standards, that the confidence of the small-holder has been generated. The crop itself can be readily harvested and converted into a saleable commodity with easily acquired skill and without much risk of deterioration. Flexibility in the demand for agro-management inputs and flexibility in the scale agrounding miles and relations in the man of production and processing have made NR an almost ideal crop for small-holders. It is this confidence of the small-holder in the rural sector of Southeast Asia that has contributed to the continued expansion of NR production through the fact and lean years of the past. To sustain the interest of the small-holder and to enhance his confidence in the industry, there is a need to modernize his operations in keeping with his aspirations and those of the region for a higher standard of living in the rural sector.



Latex being weighed at a Malaysian rubber estate

A Dynamic Production Policy

Expert projections indicate that the world will require a total elastomer supply of 15 to 17 million tonnes in the 1980s (Chart I). In a techno-economic analysis, the Malaysian Rubber Research and Development Board has estimated that NR could account for a market share of 43 per cent taking into consideration the technical and economic factors, including energy cost, petroleum prices and environmentalism. The world has finally come to accept that petroleum is an exhustible resource. Prices are no more to be considered stable and general material shortages will be a significant factor in the next decade. What this implies is that the NR supply will have to be doubled in a matter of ten years just to sustain the traditional usage of NR.

Recognizing this situation and the inevitable requirements of isoprenic rubber, synthetic cispoly/soprene capacities are being generated in certain parts of the world and considerations are being given to reviewing the culture of long forgotten rubber-bearing plants such as 'Guayule' and 'Golden Rod'. Iu the case of cis-poly/soprene, the USSR has declared her intention of creating a million-tonne capacity, while the US is investigating the commercial viability of at least two rubber-bearing plants. International agencies, such as the World Bank, have already forecast a

million-tonne shortage of NR by 1980. The con fidence in these economic forcasts is enhanced by the treent announcement by the GAS in the US that it will increase its stockpile to over 500,000 tonnes. From the historical review given earlier, the lesson is clear: that a lack of confidence on the part of NR producers, and miscalculation on the part of SR producers, and miscalculation on the part of SR producers, and miscalculation on the part of SR producers have together brought about the unnecessary transient imbalances between supply and demand and associated difficulties faced by the elastomer-consuming world. The situation calls for a dynamic producino policy in the region as a whole to ensure that NR can maximize its share in the expanding elastomer market.

"A dynamic policy cannot succeed without the active involvement of the small producers who collectively control a major proportion of rubber production in Southeast Asia. This aspect assumes importance in a view of the fact that research innovations have been traditionally slow to make any impact on the small-holder sector. To achieve the satisfactory implementation of a dynamic production policy, a review of the technologies that are already available and which can be brought to bear immediately is appropriate.

Let me, therefore, outline several salient features of the Malaysian approach, not only in relation to the success of research in the past but also in the context of a more aggressive research and development philosophy for the future.

Production Research

The theoretical limit of Heva yield capacity has been estimated at 9,000 kg per hectare. In practice today, planting materials capable of yielding more than 2,500 kg per hectare are available (Chart 2). Compared with the current national average yield in the region, which range from 500 to 1 000 kg per hectare, an accelerated replanting programme utilizing the best proven planting material already available can achieve a 50-100 per cent improvement with n a decade provided a missionary approach to replanting is adopted.

Research has produced a method of modernizing the trees already on the ground without the necessity of replanting. The innovation is yield stimulation using ethylene gas either in the form of threl or gas absorbed in molecular sieves. By stimulating trees of ten years or older in tapping, higher yield fevels in most planting materials can be secured to the extent of 60-100 per cent. Even very old trees having poor bark renewal can be stimulated with upward tapping on the virgin panel above the tapping cut. Such a technique has given 100-130 per cent increases in yield in

The immaturity period of five to six years which has been an inhibiting factor for new investments can now be significantly reduced. The use of advanced planting materials with modern agronomic practices can cut down the immaturity period to four years, and three-year target is within realization.

The concept of utilizing the Herea plant as a composite source of raw materials has show promise. With the development of precocious high-yielding materials and efficient use of stimulants to enhance later flow, a replanting cycle of twenty years becomes economically attractive. At the end of this period, the rubber timber after proper chemical treatment can be used successfully for furniture, panelling, flooring and numerous other applications, including pulp and paper. Research developments have indicated the possibility of inducing Herea trees to flower at will. The rubber seeds so produced can constitute a commercial source of semi-drying oils and fatty acids while the residues can become a supplement to cattle feed.

Advanced techniques of tissue culture, horticultural manipulation, dwarfing, discriminatory fertilizer usage are all developments at various stages in the research pipeline.

The utilization of latex as a soil conditioner in sandy soils and other poor soil structures along

with encapsulation of fertilizers have shown immediate and distinct benefits. Research achievements in biology have indeed been significant.

Some of these developments will be of immediate consequence in achieving production increase, which will become manifest in the next five years, while others are intermediate or long-term.

Products Research

The introduction of technical specifications and the use of new processing methods in Southeast Asia began in 1665. From small beganings, technically-specified rubbers in new presentations have revolutionized the image of NR in factories in consuming countries. Nearly 30 per cent of Southeast Asian produce is now represented in one from or another by technically specified grades, which are designed to retain the native excellence of the natural rubber molecule.

With the success of the technically-specified rubber schemes and their enthusiastic acceptance by consumers, the industry is fast moving towards the concept of custom processing for specified enduses. The Malaysian NR industry has already initiated 'tyre rubber' as the general purpose grade attuned to this market. This composite blend of 30 per cent latex, 30 per cent unsmoked sheets and 30 per cent field congulum with 10 per cent rubber plasticizer has been developed with the objective of obtaining a balance between volume requirements, economy and the technological properties required by the tyre sector. Such a rubber provides uniform properties, saves expensive mixing operations, avoids complex inventories and further assures consumers of the benefit of higher dispersibility in blends and of the advantages of low-temperature crystallization on storage. Consumer evaluation of volume quantities of this rubber has generated enthusiasm and interest.

Enzyme-depreteinized rubbers, oil-extended rubbers, oil-extended carbon black masterbatches, constant viscosity rubbers, superior processing rubbers and a multitude of other special purpose rubbers have all appeared on the horizon, arising from chemical and technological research. While these developments have aroused interest ranging from cursory to enthusiastic, the evolving features in consumer operations should enhance the acceptability of these materials.

NR in powder and paste forms is now becoming a reality in the production scene. A pilot plant is now in operation in Malaysia processing natural rubber lates into free-flowing powders.

The materials can withstand the rigours of shipment and a specialist market is now emerging. The process is, however, influenced by high freight cost. It is necessary, nevertheless, to evolve a more viable system to generate the availability of



"Elephant foot" budding, one of many methods to hasten maturity and to increase yield

NR powders to answer the future automation requirements of the manufacturing industry. An experimental method is now available in the laboratory to produce reversible pastes from Herea latex. While this does not completely answer the chemist's dream of producing reversible latex powder, the paste is a compromise, and technological assessment of reconstituted latex from such paste has not indicated any real problem.

The whole area of NR modification chemistry is now being reviewed in Malaysian laboratories. The underlying philosophy is whether NR can be used as a feedstock for new polymers. As the reaction and extent of modification can be controlled, it can be directed towards improving properties not only important to the radional areas of NR usage such as againg, bonding, abrasion resistance, adhesion, etc., but more important, to the incorporation of special properties such as gas impermeability, solvent resistance, thermo-plasticity, etc. Modification techniques attuned trailloring hardness, resilience and glass transition temperature to specific engineering uses have been made possible and practical.

A number of consumer-oriented developments have appeared from research, including network

bound anti-oxidants, efficient and semi-efficient vulcanization systems and the revolutionary development of di-urethane cross-linking.

All these products indicate the requirement of a new dimension in research philosophy quite apart from the conventional approach of protecting the traditional areas of uses. Achievements today have been significant, but possibilities for the future are even more exciting and immense.

Planned Scene of the Future

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Production Research

The theoretical limit of Heveu yield capacity has been estimated at 9,000 kg per hectare. In practice today, planting materials capable of yielding more than 2,500 kg per hectare are available (Chart 2). Compared with the current national average yields in the region, which range from 500 to 1,000 kg per hectare, an accelerated replanting programme utilizing the best proven planting material already available can achieve a 50-100 per cent improvement with n a decade provided a missionary approach to replanting is adopted.

Research has produced a method of modernizing the trees already on the ground without the necessity of replanting. The innovation is yield stimulation using ethylene gas either in the form of threl or gas absorbed in molecular sieves. By stimulating trees of ten years or older in tapping, higher yield levels in most planting materials can be secured to the extent of 60–100 per cent. Even very old trees having poor bark renewal can be stimulated with upward tapping on the virgin panel above the tapping cut. Such a technique has given 100–130 per cent increases in yield in recent trials.

The immaturity period of five to six years which has been an inhibiting factor for new investments can now be significantly reduced. The use of advanced planting materials with modern agronomic practices can cut down the immaturity period to four years, and three-year target is within realization.

The concept of utilizing the Hevea plant as a composite source of raw materials has show promise. With the development of precocious high-yielding materials and efficient use of stimulants to enhance latex flow, a replanting cycle of twenty years becomes economically attractive. At the end of this period, the rubber timber after proper chemical treatment can be used successfully for furniture, panelling, flooring and numerous other applications, including pulp and paper. Research developments have indicated the possibility of inducing Hevea trees to flower at will. The rubber seeds so produced can constitute a commercial order of semi-drying oils and fatty acids while the residues can become a supplement to cattle

Advanced techniques of tissue culture, horticultural manipulation, dwarfing, discriminatory fertilizer usage are all developments at various stages in the research pipeline.

The utilization of latex as a soil conditioner in sandy soils and other poor soil structures along

with encapsulation of fertilizers have shown immediate and distinct benefits. Research achievements in biology have i deed been significant.

Some of these developments will be of immediate consequence in achieving production increase, which will become manifest in the next five years, while others are intermediate or long-term

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The introduction of technical specifications and the use of new processing methods in Southeast Asia began in 1165. From small bigninings, technically-specified rubbers in new presentations have revolutionized the image of NR in factories in consuming countries. Nearly 30 per cent of Southeast Asian produce is now represented in one from or another by technically specified grades, which are designed to retain the native excellence of the natural rubber molecule.

With the success of the technically-specified rubber schimes and their enthusiastic acceptance by consumers, the industry is fast moving towards the concept of custom processing for specified enduses. The Malaysian NR industry has already initiated 'type rubber' as the general purpose grade attuned to this market. This composite blend of 30 per cent latex, 30 per cent unsmoked sheets and 30 per cent field coagulum with 10 per cent rubber plasticizer has been developed with the objective of obtaining a balance between volume requirements, economy and the technological properties required by the type sector. Such a rubber provides uniform properties, saves expensive mixing operations, avoids complex inventories and further assures consumers of the benefit of higher dispersibility in blends and of the advantages of low-temperature crystallization on storage. Consumer evaluation of volume quantities of this rubber has energated enthusiasm and interest.

Enzyme-depreteinized rubbers, oil-extended rubbers, oil-extended carbon black masterbatches, constant viscosity rubbers, superior processing rubbers and a multitude of other special purpose rubbers have all appeared on the horizon, arising from chemical and technological research. While these developments have aroused interest ranging from cursory to enthusiastic, the evolving features in consumer operations should enhance the

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"Elephant foot" budding, one of many methods to hasten maturity and to increase yield

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The whole area of NR modification chemistry is now being reviewed in Malaysian laboratories. The underlying philosophy is whether NR can be used as a feedstock for new polymers. As the reaction and extent of modification can be controlled, it can be directed towards improving properties not only important to the traditional areas of NR usage such as ageing, bonding, abrasion resistance, adhesion, etc., but more important, to the incorporation of special properties such as gas impermeability, solvent resistance, thermo-plasticity, etc. Modification techniques attuned to tailoring hardness, resilience and glass transition temperature to specific engineering uses have been made possible and practical.

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A mature tree yielding latex

but modification at the cell Jevel through tissue culture. All high-yielding planting materials would have guaranteed average yield levels in excess of 3,000 ke/ha/yr during their productive period. Discriminatory manuring and effective intercropping programmes would be exercised. Rubber reeds generated through induced flowering will provide adequate materials for centralized processing into semi-drying oils and fatty acids. Replanting programmes will be based on a 20-year cycle. At the end of 21 years, the tree will generate adequate timber as a continuous and constant source for furniture, panelling, flooring, and pulp for the paper and packaging industry.

Exploitation systems would be based on those applicable to the new variety of Hevea which would respond to millimetre cuts. This would entail a revolutionary tapping system allowing a worker to tap more than a thousand trees. Stimulation would be carried out soon after maturity. Collection of latex will be in polythene bags at monthly intervals. Liquid latex will only be collected for special parposes for reversible paste manufacture and for latex compounding. All agricultural operations will cease with tapping, when industrial operations will commence collection of the polythene bags of latex. Such operations will be in modern central factories, processing

more than a hundred tonies a day. Only one general purpose grade of natural rubber, that is, SNR, will be preduced and this will be cleaner and technologically superior to RNS 1, while all other rubbers will be taitor-modified ones. These central factories will bave facilities not only for processing latex and rubber for export but also for custom-compounding and manufacture of selected rubber items. Special-purpose synthetic polymers with plastic a d elastomeric properties will also be manufactured in these factories for blending with natural rubber to impart certain special properties for new areas of application.

Marketing operations will be centralized into large units with technical services being provided both force and after sales to all customers. An international buffer stock of adequate capacity will be in operation to ensure price stability at equitable levels.

As the dynamic production policy gains momentum, modification chemistry will become manifest. Natural rubber will not only enter wider areas of engineering applications but will appear in the market in forms other than those with elastomeric properties. The product may be gas impermeable, thermoplastic and even in liquid form. As NR becomes modified and admixed with special polymers having elastic, fibrous, plastic and resinous properties, it will fully integrate with polymeric materials per se. It may even lose its identity, although it would certainly retain its native, techno-economic excellence.

This scene is not overly optimistic, nor is it a figment of the imagination. Nor can it be relegated as a science fiction. The scene depicts exciting possibilities which must be achieved as we progress into the next hundred years. However, a pragmatic approach is required for the immediate ten years ahead. In this veni, the ANRPC is at present in the process of evolving "agro-economic norm", which aims at specifying the production potential of natural rubber in the ANRPC region. The initial assessments have not produced the real optimism envisaged. The world today has only a production potential of some 3.3 million tonnes. If we move into the next ten years without an aggressive promotional effort, that is, massive new investments and reinvestments followed by dynamic production, we, as producing countries, will be unable to take advantage of the exciting situation now open for the biologically-based polymers, especially natural rubber.

With renewed confidence and acceptance of the challenge to meet the material shortage of the future, research innovations available are clearly indicative that the world's requirements of isopremic rubber in the 1980s and 1990s can be met. Through the international price stabilization effort,

the ANRPC countries have established initiative in a co-operative approach. Similar co-operation in research is manifest among the IRRDB producing countries. In the IRSG and other world foral natural rubber producers have coming to terms with synthetic producers and consumers. As we step into the next decade of the next hundred years for this country, areas of co-operation will expand among natural rubber producing countries and between natural and synthetic rubber industries. We must, therefore, be receptive to these requirements. Demands on scientific research and development and implementation of innovations in the producing scene are bound to be more sophisticated, more massive and more compelling sophisticated, more massive and more compelling.

than in the past.

In an interdependent world, which is beset with energy/material prhblems, environment hazards and population explosions, it is essential that natural rubber producers from developing countries and synthetic rubber producers from the intustrialized consuming countries must move closer together in furthering their mutual interests affecting both the present and future generations. Decisions must be made. The preference of present individuals, if I may borrow the terms of welfare economic theory on social time preference, must be allowed to determine the preference and welfare of future generations.

New Promising HY Clones Under Study

The Rubber Research Institute of India had initiated work on breeding and selection, with a view to evolving modern high yielding *Herea* clones indigenously, in 1954.

In the 1958 hand pollination programme, 14 clones were used as parents and 21 combinations were attempted. About 500 clones were evolved from these crosses and they have been under preliminary testing at the Kodumon Estate of the Plantation Corporation of Kerala Ltd.

The planting was done in 1960, the trees were opened in 1969 and the yield was under observation since 1970. Though the area was opened only in 1969, many of the clones had attained tappable girth much earlier. Eleven promising clones from this series have been selected on the

basis of comparative performance of yield and vigour for large scale experimentation.

On preliminary testing with limited number of trees, the yield and vigour of these selections are found promising. The yield data during the first seven years of tapping show that some of these selections are highly promising.

The highest yielders are H. P. Nos. 466, 140, 311 and 52 whose average yield ranges from 74 gms to 77 gms per tree per tap compared to 42 gms per tree per tap of the the control. Tjir-1. Some of the selections also attained tappable girth one year ahead of the control. Anatomical studies support the yielding capacity of these selections.

Further observations are in progress.

Nendran Banana: A Profitable Intercrop For Small Rubber Growers

Budded stumps of the clone GT-1 were planticed adopting a spacing of $5m\times 5m$ in June 1976 at the Institute's Central Experiment Station, Ranni. In January 1978, banana suckers were planted there at a spacing of $5m\times 2.5m$ so that banana and rubber plants were in alternate rows and they were raised as rainfed crops.

Banana plants were manured with 8:8: 16 NPK from April to October 1977. Cultural operations such as shallow tilling of the soil, mulching plant bases and proping of the plants were carried out as usual. Harvesting of bunches was started from December 1977 and continued till the end of

February 1978. The produce was sold at the rate of 80—100 Ps. per kg. depending upon the quality of produce.

A gross income of Rs. 5,060 per ha. was realised against a total expenditure of Rs. 3,250/... In addition to this, suckers to the value of Rs. 700/per ha. were also available, thus bringing the total net profit by raising one crop of nendran banana to Rs. 2,510/- per ha.

Raising one crop of banana does not pose any problem for the establishment of leguminus ground covers during the year of planting rubber. Thus the growers will be in a position to take advantage of both the intercrops and cover crops.



Reproduced here is a report prepared by an ad hoc Panel of the Board on Agriculture and Renewable Resources, Commission on natural resources, Advisory committee on Technology innovation, Board on Science and Technology for International Development, and Commission on International Relations and published by the National Academy of Sciences, Washington. This report examines the state of knowledge and the future promise of Guayule—Parthenium argentatum Gray—a little known shrub native to the desert of southwest Texas and northern Mexico that was a commercial source of natural rubber during the first half of this century. The panel which made this report was comprised of internationally reputed Botanists, Engineers, Chemists, Rubber Tachnologists and a Rubber Economist. The mandate of the panel was to analyse guayule's strengths and limitations as a modern, commercial crop, to identify areas of uncertainty and judge the wisdom of renewed development and research. The panel was specifically charged to consider the potentialities of guayule for providing employment and enabling better use of land on Indian reservations in Texas, New Mexico, Arizona and California. The report was prepared in November, 1975.

1 Background

When the conquering Spaniards, in the 1500s, reached what is now Mexico they discovered Aztecs playing a game similar to basketball, with a bouncing ball and a stone ring for a goal.
Rubber for the balls was extracted from latexcontaining plants. In the northern semidesert highlands, the stems of guayule bushes were used. The Indians chewed them, spitting out the rubber and vegetable matter separately.

For several centuries guayule was no more than a curiosity, although, because its rubber and resin burned fiercely, it was often used to fire smelters extracting silver from rich ores in northern Mexico's Chihuahuan desert region. During the first decade of this century, however, the guayule bush attracted attention as a source of natural rubber. Scores of patents were issued to would-be entrepreneurs and more than a dozen rubber-extraction factories were built in

In 1910 about 50 percent of U.S. rubber was extracted from wild guayule shrubs. A number of the industrial leaders of the day (led by Bernard Baruch and including John D. Rockfeller, Thomas Fortune Ryan, Nelson W. Aldrich, and Daniel Guggenheim) invested 30 million dollars in a guayule company, the Continental-Mexican Rubber Company.

As a result, Mexico became a rubber-exporting country. Francisco Madero, scion of one of the wealthiest guayule-growing families, became president of Mexico in 1910–1946. The United States imported more than 150 million pounds States imported more than 190 million pounds (68 million kg) of Mexican guayule rubber. For example, in 1912, 16 million pounds (7 million kg) were imported at a price of 48,5 cent per pound (\$1.09 per kg). About 1910, when it was thought that guayule fortunes were soon to be made, there was a boom in desert land in the

But the wild stands, though extensive, could not endure such sustained harvesting. No replanting, cultivation, or rotational cropping was then practiced and the reckless exploitation resulted in the complete devastation of the wild guayule stands. By 1912, therefore, many mills had been forced to close. Then revolution broke out across northern Mexico, causing abandon-

The Revolution, for example, forced the Continental-Mexican Rubber Company to retreat across the border. In Arizona, and later in as a cultivated crop. Its efforts received a large boost in the 1920s when the British Government restricted the amounts of rubber it would sell to the rest of the world. Using the rubber from its

giant plantations in the crown colory of Malaya (now Malaysia) as an economic lever, the British unilaterally increased rubber prices threefold. With this incentive, the company planted \$,000 cares (3,240 ha) of guayule in California and, during the late 1920s, over 3 million pounds (1.4 million kg) of rubber were extracted. The rubber sold profitably at prices competitive with those of hevea rubber. But the onset of the Depression tumbled rubber prices to 2 cent per lb (4.4 cent per kg), ruined the British scheme,* and arrested guayule development.

In 1930, the War Department recognized the danger that the United States could be cut off from rubber supplies. Dwight D. Eisenhower, then a major, was assigned to study the use of guayule as an alternative. His report urged that guayule plants growing in the United States be protected and reserved for strategic emergencies and that guayule development be supported by the federal government. However, the advice was ignored, and in December 1941 the United States and its allies lost more than 90 percent of their rubber supply when Japanese forces invaded Southeast Asia

A massive "Emergency Rubber Project" (ERP) was initiated in February 1942. More than 1,000 scientists and technicians were assigned to guayule production and research. In 31 years, supported by a work force of 9,000 workers, the ERP planted almost 32,000 acres (13,600 ha) of ERP planted almost 32,000 acres (13,000 ha) of guayule at 13 sites in 3 states. It produced one billion guayule seedlings and 3 million pounds (1.4 million kg) of resinous rubber for the war effort (see Figures 1). Toward the end of the program, 15 tons of rubber were produced daily in factories at Salinas and Bakersfield, California. Four guayule mills were constructed in Mexico: by the end of 1942, they were processing 180 tons of shrub in a 24-hour day.

However, in 1943, as a result of government investments of several hundred million dollars, synthetic elastomers began to be produced in synthetic elastomers began to be produced in commercial quantities. This industry quickly expanded. At war's end, with the presence of the synthetic elastomer industry and with surplus stocks of hevea rubber in Southeast Asia, the economic and strategic justification for continued guayul production seemed to have disappeared.

[&]quot;In the 1930s a cartel of rubbes-producing countries (inding Malays, Ceylon, the Dutch East Indies, and Feedback and Control of the Public East Indies, and Feedback and Feedb



Figure 1. Irrigated guayule grown by the Intercontinental Rubbet Company near Salinas, California circa 1941. These plants have been in the field less than 4 months. For 20 years the crop was commercially produced in this temperate, winter-unfaill region. During the period 1924-60 the feedral government operated this plantation; 8,000 cares (3,000 ha) of guayule were grown to harvestable size (U.S. Department of Agriculture)

been leased in 1942. But by 1946 wartime inflation had made the rents paid by the ERP totally inadequate, and the farmers pressured the Congress to return their land. Accordingly, in 1946 the 77th Congress terminated funding for the ERP and ordered that the guayule bushes already planted be destroyed. An estimated 21 million pounds (10 million kg) of rubber in 27,000 acres (11,000 ha) of guayule plantations that were reaching maturity were burned or disked into the ground. Further, most of the seed from the genetic improvement program was destroyed along with hundreds of millions of seedlings.

After 1946, the U. S. Department of Agriculture continued to investigate guayule, but its efforts were inadequately funded. Nevertheless, promising genetic improvements and breakthroughs in processing and rubber quality were made. Following up research advances made by Japanese-Americans interned during the war at Manzanar Relocation Center in the Owens Valley, California (see Figure 2), machinery designed to pulp wood for paper production was used experimentally to mill guayule shrubs. Also, new techniques were developed for leaching out the resins that lower guayule rubber's quality, Deresination and the use of wood-pulping mills greatly improved the quality of the rubber produced and, in road tests in 1953, heavy-duty truck tyres made from deresinated guayule showed properties equivalent to those made from hevea rubber.

Nonetheless, in 1953 the federal guayule research program (at the U. S. Natural Rubber Research Station, Salinas, California) was terminated. The Continental-Mexican Rubber Company (then known as the Intercontinental Rubber Company) was purchased—for its New York Stock Exchange listing—by Texas Instruments Incorporated, and its rubber production also ceased.

Concurrent with the U. S. efforts, attempts to cultivate guayule were made in Australia, Argentina, Mexico, Spain, Turkey, and the Soviet Union. These continued through the 1950s, but the world rubber situation continued to militate against guayule and the plantations were abandoned. Currently, there are no commercial guayule plantations anywhere in the world, though experimental plots have recently been established in Israel, Arizona, and California.

Only in Mexico did guayule development continue, and as a result of Knowledge accumulated during recent decades two agencies of the Mexican government (the Conejo Nacional de Ciencia y Tecnologia and the Comision Nacional de las Zonas Afridas) are now embarking on rubber production from what they estimate is 2.6 million tons of adult guayule shrub growing wild in about 10 million acres (4 million ha) in the States of Coahulla, Zacatecas, Chihuahua, Nuevo Leon, and San Luis Potosi. The plan is to harvest 300,000 tons annually in order to produce 30,000 tons of deresinated guayule rubber. A pilot plant to procees one ton of shrub daily was completed in March 1976. Incorporating advanced technology from the synthetic rubber that is deresinated and of far higher quality than that previously produces guayule rubber that is deresinated and of far higher quality than that previously produced. In August 1976 tires were manufactured from guayule rubber and are now undergoing testing.



Figure 2. Unirrigated gusyule, Manzanar, California circa 1943. In this barren, semiarid, winterrainfall location in the Owen's Valley gusyule was grown as a dryland crop during the period 1942-44. The work was done by Japanese-Americans flowibly detained in a relocation caumo. Guided by Professor Robert Emerson of the California Institute of Technology they greatly advanced gusyule technology by prioneering the use of wood-bujining machinery for milling gusyule shrubs. (C. Emersion)

2 The Plant

Guayule is a member of the sunflower family. Compostae, and belongs to the genus Parthenium. There are 16 species of Parthenium: guayule is Parthenium argentatum, so named because of a silvery shen on its gray-green leaves. It is the only Parthenium species known to produce rubber in any quantity.

A bushy perennial shrub (Figure 3), guayule has narrow leaves, covered in a drought-protecting white wax, that alternate along the stem, and a canopy of small flowers borne on exceptionally long stems. Usually only about 2 feet (60 cm) high, it is long-lived and hardy; it may survive along a feet of the stem of the s

Native to a semiarid area in north-central Mexico and southern Texas, guayule occurs in stands scattered throughout 130,000 sq mi (337,000 sq km) of the Chihuahuan Desert and surrounding regions. In the United States, the shrub is found wild in the Trans Pecos area (Stockton Plateau and Big Bend region) of southwestern Texas.

Guayule's native habitat is a semiarid plateau 4,000-7,000 ft (1,200-2,100 m) high. In this area it withstands temperature between 0° and 120°F (-18° and 49°C). Heat appears not to affect this desert-adapted plant, but at temperatures below 60°F (16°C) its growth rate slows; below 40°F (4°C) it becomes semidormant; freezing temperatures sometimes kill it.

The plant develops a taproot that may penetrate the soil more than 20 ft (6 m), supplemented by extensive fibrous roots that may spread up to 10 ft (3 m) laterally. This root network allows guayule to absorb moisture from a large volume of desert soil and thus to withstand periodic drought. For severe and extended droughts the plant has another survival mechanism; it becomes dormant. In some parts of Mexico, guayule has survived by this means, despite the virtual absence of rainfall for several years.

In guayule's native habitat, 9-16 in. (230-400 mm) of rain falls annually (mainly in the summer months). The plant grows best in well-drained soils and cannot tolerate waterlogging. In nature it grows in a wide variety of shallow, stony, calcareous, and friable soils.

Unlike the rubber in Herea and other latesproducing plants, guayule rubber is not contained in ducts, but in single, thin-walled, cells. These rubber-filled cells are mainly in the outer layers (in the cortical tissues and the medullary rays) and mostly in new-grown tissues, but the old cells of the inner xylem and pith produce rubber for several years. Two-thirds of the rubber is in the stems and branches, the remainder in the roots. There is no rubber in the leaves.

The rubber is suspended in cell sap to form a latex as in other rubber-producing plants. Unlike Hevea, however, guayule produces no natural anti-oxidant and the rubber in its latex rapidly degrades upon contact with air.

In native guayule bushes rubber constitutes, on the average, about 10 percent of the total weight of the plant (day weight). But gnayule has considerable genetic variability: in the wild it exists in a large number of strains—indeed almost every plant is a separate strain. Some of these contain much rubber, others almost none. In the 1940s, strains containing up to 26 percent rubber were found. However, the strains that were widely cultivated had been selected prewar and were able to produce about 20 percent rubber (dry weight) after 4 year's growth.

The rubber yield depends not only on genetic makeup but also on environmental conditions. When guayule grows actively it produces little or no rubber. If the plant is stressed, growth slows and the products from photosynthesis are diverted into rubber production. Thus when growth slows during cool weather or because of reduced moisture supply, the rubber content begins to increase.

Apparently rubber is not used or metabolized by the plant because it continues to accumulate for at least 10 years; plants can remain in the field for even longer periods without serious loss of rubber. Experiments have shown also that if guayule plants are deprived of all carbohydrates, and other energy sources, they still fail to utilize their rubber as an energy source.

Resin duets are found throughout the shrub, and resins (which include terpenes, sesquiterpenes, diterpenes, glycerides, and low molecular-weight polyisoprene hydrocarbons) constitute 10-15 percent of the plant (dry weight). Guayule flowers are pollinated by wind and by insects. The tiny seeds are produced at a prolific rate; a plant can yield several thousand after a single rainfall. Vigoronsly growing plants bloom and set seed continuously throughout summer and fall. If stored carefully the seeds can remain viable for several decades; some 20-year-old seed has recently been planted in Israel with over 90 percent germination. Flowers and seeds are produced as early as six months after germination.

Guayule is usually propagated by nurserygrown seedlings, though grafts and cuttings can be successful. Young seed requires a simple treatment to break dormancy.

Guayule has much inherent genetic variability and is amenable to genetic improvement. Individual plants with chromosome numbers of 2n = 36 to 100 or more are known. The guayule types of 2n=36 are completely sexual and reproduce in the usual way, involving pollination (double fertilization). The guayule plants of higher chromosome numbers reproduce without requiring double fertilization (these are termed "apomicts"). Many guayule populations reproduce apomictically, that is, the embryo of their seed arises from a non-fertilized nucleus and thus reproduces a plant that is genetically identical to the parent.

With sexual types the plant breeder can develop hybrids with useful characteristics. These hybrid plants can then be induced into apomictic forms to replicate the characteristics of the hybrid, generation after generation. This facilitates guayule breeding.



Figure 3. Guayate growing wild in Zacatecas State, Mexico. Rubber is found in thin-walled cells throughout the stems, branches, and roots. Le ives contain no rubber. Some strains have yielded up to 20 percent rubber (day weight basis). (N. D. Victmeyer).

Guayule can be hybridized with other Parthenium species, e. g., P. Incanum, P. tomeniouum, and P. stromonium. Hybrids can be sexual or apointicle. The hybrids with P. stramonium and P. tomeniouum in particular show considerable promise for improving guayule, for the hybrids are much bigger plants than guayule and some of them contain rubber. Crosses with P. incanum offer opportunities for greater cold clerance. Crosses with other Parthenium species still remain to be attempted.

3 Agricultural Production

For a crop that is not now produced, guayule's agriculture is remarkably well-known; almost a thousand scientific papers have been written about the plant, including excellent manuals for germinating seed, caring for seedings, transplanting, fertilizing, irrigating, and harvesting. This knowledge is based largely on empirical observations made during 40 years of commercial production and during the period when the Emergency Rubber Project was active, in which over 30,000 acres (12,000 ha) of guayule were cultivated in California.* Wartime urgency demanded that good-quality agricultural land and adequate irrigation be used. Thus, the work of the ERP is perhaps a misleading model for a desert plant, but basic features of guayule agriculture were learned and many agronomic techniques developed.

The ERP experience showed that there were no insurmountable difficulties in growing guayule. There are no fundamental barriers to be overcome before production can begin. The ERP plantations and experimental plannings provide guidelines for producing rubber under a wide variety of soil and climatic conditions.

Climate Needs and Irrigation

Moisture is perhaps the most important determinant in guayule growing. Although the plant can produce rubber in very dry climates, it is not clear that it can be economically cultivated in regions as arid as much of its native habitat. This is because where rainfall its deficient and drought common, the plant is hard to establish and may take more than 7 years to develop commercially useful quantities of rubber.

In its native habitat, annual rainfall can be less than 9 in. (230 mm), but ERP researchers concluded that 11–25 in. (280-640 mm) annually is needed for commercial rubber production. About 16–18 in (410–460 mm) was recommended for production on a long rotation (4–8 years)

*Salinas area, 8,000 acres (3,200 ha); Fracy-Newman, 12,000 acres (5,000 ha); Bakers-field, 9,000 acres (3,600 ha); and Southern California (Indio, Carlsbad, and San Clemente) 2,000 acres (800 ha)

The guayule plant can survive arid conditions, but if annual rainfall is less than 14 in. (356 mm) supplemental irrigation is needed to give a worth-while yield of rubber in a reasonable time. When annual moisture exceeds 25 in. (640 mm) excessive vegetation growth, rather than rubber formation, may occur.

The highest yields recorded for cultivated guayule have been obtained with irrigation. Irrigation allows the farmer to control the moisture that the plants receive; it can force growth, shorten the production cycle, and extend guayule production into areas where rainfall is unreliable.

To meet guayule's peculiar need for stress periods that cause it to produce rubber, both irrigation and rainfall must be unevenly distributed year-round. Definite dry seasons appear necessary and of course with irrigation these can be induced at will in arid regions.

Wild guayule bushes have survived temperatures well below freezing, but in plantations the plants (especially young seedlings) are frost sensitive. For survival, guayule plantated in frost-prone areas requires careful tending. A frost of 20°F (-7°C) can injure tender plants, but those previously induced into dormancy ("bardened off") by exposure to gradually decreasing temperatures or by reduced irrigation are not harmed by much lower temperatures.

Soils

To produce guayule successfully, a soil's moisture-retention characteristics are most important. Well-drained soils are needed and the ERP project concluded that sandy loam was best. The plant does not grow well in compacted and poorly drained soil.

Guayule appears to need little fertilizer, will grow well in moderately fertile soils, and is not a serious soil-depleting crop. While fertilizer improves vegetative growth it does not necessarily increase the amount of rubber produced. The optimum fertilization for maximum rubber produ-

Guayule does not appear to be very salt tolerant. Because of high evaporation, salt buildup could cause problems if the plant is grown with irrigation in arid regions.

Field Production

Several years are needed for guayule to attain an economic size and rubber content. Irrigation is the most important factor in hastening the growth rate and, with irrigation, guayule can be brought to economic harvest size in 3 years. In experiments, productive harvests have even been made at the end of the second year. Under dryland farming it is generally thought that much longer periods are required for economic production.

Guayule is suited to highly mechanized agriculture; engineers in the ERP developed and used machinery to handle each step in production from seed gathering to baling the harvested shrubs. Guayule lends itself to many modern agricultural implements: conventional tillage equipment to prepare the land; mechanical tree planters to plant seedlings; corn or cotton cultivators, digger-harvesters, and hay balers to bale the shrubs for

All commercially cultivated guayule has been produced from seedlings grown in a nursery and transplanted to the field. Toward the end of the ERP some researchers found that, with special care, seeds could be planted directly in the field. But guayule seeds are tiny—the size of lettuce seeds—and they must be carefully planted in light soil very close to the surface. Here they are vulnerable; both wind and sand splash (from sprinkler irrigation) can bury them too deep for successful germination, or leave them uncovered—with fatal results. Furthermore, during the first 5 weeks, weeds can completely smother the tiny, tender seedling. A nursery allows better control of these difficulties.

During the ERP, guayule seedlings were grown in nursery beds 4 ft (1.2 m) wide and 400 ft (120 m) long. Over 45,000 of these were planted during 1942.* Serious losses were encountered during transplanting unless the seedlings were first induced into a near-dormant state by cold or drought.

The plantation's first year is a critical time, since the small seedlings are easily smothered by weeds. In later years, less cultivation is needed and a point is quickly reached where guayule shades out weeds and robs their roots of moisture; then little or no further weeding or cultivation is needed.

Pest Control

In the wild, guayule appears remarkably free of disease and insect pests, but under cultivation the

*The final report of the Emergency Rubber Project gives some concept of the magnitude of the project. Describing establishment of the initial lot of seedbeds, the report (page 47) states: "One of the first purchases made at Salinas involved the procurement of 3,500 tons of [specially dried] sand. Since 11,786 seedbeds, each 400 feet long, were sown, and each bed contained seven rows of seed, the 3,500 tons of sand was eventually deposited in bands whim, if joined end it ond, would extent from the Allantic Ocean to Gibrallar!"

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plants are susceptible to both. Although few plants died from disease or pests in the huge areas of plants cultivated in the ERP, infestations were found nonetheless. The diseases are the common ones that affect other crops such as cotton and lettuce. Some are quite serious, such as cotton root-rot, charcoal rot, dieback, and wilt. A few days in standing water encourages Phytophthora rot on guayule roots. Irrigation must always be carefully managed to avoid waterlogging.

Guayule is reportedly highly resistant to root-knot nematode.

Plantation guayule can be damaged by several insects (grasshoppers were the worst insect pests in the ERP), particularly during the seedling stage. Today these insects can undoubtedly be controlled with insecticides.

Harvesting

Guayule is normally harvested, roots and all, with a tractor-drawn digger (see Figure 4). The shrubs are then baled for transport to an extraction mill.

Important research advances have been made with pollarding guayule. In this method (also known as coppicing) the bushes are mowed off about 2 in. (5 cm) above the ground so that only the trunk, branches, and leaves are harvested. The roots (containing about one-third of the plant's rubber are left in the ground to produce new growth. Most roots resprout and grow into new shrubs so fast that a one-year-old pollarded bush becomes as large as a two-year-old seedling. Comprehensive analysis still remains to be done, but in principle this method rapidly produces two crops while avoiding the expensive replanting normally required. Whether more than two crops can be harvested without replanting is unknown.

Dry-land (Nonirrigated) Production

Guayule's water requirements are not wellenough known for us to accurately predict what a rubber yield will be in a given location. Yet a major hope for the future is that guayule can be grown in land that is not now used for conventional crops. In this way it would not compete with food production.

As a native of desert regions, guayule has potential to be grown where rainfall is too sparse or too unreliable for other crops. But though guayule will grow in such areas, it is not known whether dry-land farming can be profitable. To determine this more accurately is one of the main research needs in guayule production.

A detailed analysis of the possibilities for growing unirrigated guayule in California was



Figure 4. Guayule is adapted to mechanized agriculture. All the operations involved in producing it (for example, seeding, transplanting, cultivating, barvesting, and baling) have been mechanized. Here a combine havester picks up shrub, chops and blows it into a waiting truck for transport to a baler or factory. (Intercontinental Rubber Company, Salmar, Calfornia, January 1931)

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4 Rubber Extraction

As already noted, the latex in guayule shrubs is found in the roots, stems, and branches; to obtain it the whole plant is processed. The latex is contained in microscopic cells, which are not connected; hence guayule plants cannot be tapped like rubber trees. The rubber must be physically or chemically separated from other components in the harvested shrub; dirt and

rocks (caught on the roots), leaves, woody vegetable matter, cork, cellular juices and resins (see Table 1).

This complicated separation can be accomplished with up to 95 percent rubber recovery. It can be done with a sequence of fairly standard and continuous processes

Guayule plants, unlike Hevea, contain no antioxidant, nothing to retard oxidative degradation of the rubber once the cells are exposed to air. Thus the shrub must be kept intact and processed within a few days of harvest. In addition, each processing step must be conducted

TABLE 1

Components of harvested guayule shrubs

45-60 percent
8-26 percent*
5-15 percent*
50-55 percent*
15-20 percent*
1— 3 percent*
10-12 percent*
Variable

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Parboiling

In the first step, the shrubs are dipped in het water (10 minutes at 75°C [167°F]). This coagulates the rubber in the latex cells, which decreases its deterioration during processing and simplifies its separation from the vegetable matter. Parboiling also removes much of the soil from the roots, but perhaps most important, it removes

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Guayule plants, unlike Hevea, contain no antioxidant, nothing to retard oxidative degradation of the rubber once the cells are exposed to air. Thus the shrub must be kept intact and processed within a few days of harvest. In addition, each processing step must be conducted without excessive delay.

TABLE 1
Components of harvested guavule shrubs

Moisture	45-60 percent
Rubber	8-26 percent*
Resins	5-15 percent*
Bagasse	50-55 percent*
Leaves	15-20 percent*
Cork	1- 3 percent*
Water Solubles	10-12 percent*
Dirt and Rocks	Variable

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the leaves, which contain no rubber. Defoliation greatly benefits processing by reducing (up to 20 percent) the bulk of material to be handled and increasing mill capacity. It also improves the final product, for the leaves contain copper, managanese, and resinous compounds that contaminate the rubber and catalyze its degradation.

Milling

To release the rubber from the cells the plant tissue must be separated and disintegrated. Although older processes used equipment designed for ore crushing, research has shown the superiority of pulping machinery designed to separate wood fibers and release lignins in paper manufacture. At Manzanar and in the final phases of the U. S. guayule project a Jordan Mill was used; the current Mexican project uses a Bauer Mill. Both of these mills are used in the paper industry for making pulp. Prior to pulping, guayule shrubs are coarsely hammer milled. Caustic soda is added because during the pulping process it helps break open the rubber-filled cells and promotes separation of the rubber from the vegetable matter.

The pulping is done in water, which causes the rubber and brown, pungent resins to agglomerate into a spongy form known as guayule "worms".

Rubber Separation

In a large sturry tank (as used in manufacturing wood pulp) the slurry of pulped shrub separates: the waterlogged bagasse sinks, the worms float and are skimmed from the surface. In a second tank the crude worms are again stirred in a slurry tank, the rubber skimmed from the surface, and residual bagasse separated.

The tacky, resinous worms are then rinsed to remove caustic soda. They are difficult to handle and gum together, trapping water, cork, and fiber between them. To keep tnem small, manageable, and easy to deresinate, the worms are next warmed in water containing a little surfactant (detergent).

Deresination

Guayale worms contain about 17-25 percent of resins. To remove resins, the small (1 mm diameter in the surfactant-treated Mexican product), highly porous worms are extracted with warm acetone, a common industrial solvent. A fluid-bed process is used, and in only minutes the acetone carries away about 95 percent of the resins together with much water. The acetone then is distilled from the resin/water mixture

*Unlike hevea rubber, guayule rubber contains little gel and dissolves satisfactorily in hexane or cyclohexane. In the Mexican process the solution used contains about 5 percent rubber. and recycled. After steam sparging to remove residual acetone, the grey-white guayule rubber contains about 2 percent resins, as well as cork and debris that failed to sink in the slurry tanks.

This method produces a uniformly deresinated rubber, which can be dried with standard equipment: a screw press followed by a hot-air drier.

Final Purification

The Mexican government's guayule project incorporates and ultimate-purification step that takes advantage of modern developments in the synthetic-rubber industry. The deresinated rubber is dissolved in solvent.* This solution can be readily filtered to remove residual insolubles (cork, fiber, dirt). The filtered solution is homogeneous and the rubber can be bleached, protected with antioxidants, or treated with other reagents to give a high-quality, uniform product.

But perhaps more important is the power that the solution phase gives the manufacturer to chemically modify the rubber. In solution the rubber can be altered by polymerization, chlorination, copolymerization with methacrylates, and by other chemical reactions that produce rubbers with different properties.

Coagulated from the solution with wet steam, the recovered rubber is homogeneous and high quality with exceptionally low amounts of ash, copper, and iron * Constant-viscosity rubber can be obtained by this method. By adding surfactant during coagulation, a powdered rubber suited to bulk handling can be obtained, unthinkable with the tacky guavule of the past. *

Alternative Methods

In the 1950s the U. S. Natural Rubber Research Station developed an alternative method for separating the rubber from small pieces of floating debris that accompany the worms from the slurry tank. A pressure vessel was used to waterlog the debris (cork and cellulosic waste) which in a sub equent slurry tank would sink, leaving only the worms floating. The worms were then deresinated, using acctone, as in the Mexican process.\(\frac{1}{2}\) The product, though not equaling the quality of the Mexican rubber (e.g., it contains about 3 percent benzene-insoluble material).

A partial deresination method called 'retting" was used on a small scale in the 1930s, and '40s. In this process the harvested shrubs were moistered and stored in the air. Under these conditions molds and bacteria decompose some of the resins that most seriously lower rubber quality. The rubber is then milled out of the retted shrub in the normal manner.

^{*}Furthermore, the solvent is washed, distilled, and recycled.

[†]Information supplied by E. Campos-Lope,

nonetheless can probably fill many of the commercial end uses that now employ hevea rubber, and it may be cheaper because it avoids the costs of solution-phase purification

5 Rubber Quality

Freshly extracted guayule rubber contains about 20 percent clove-scented liquid tars, called resins. Almost all the guayule rubber sold in the past was in this tarry form. It was inferior to hevea rubber (which has only 2 percent non-rubber content), its physical properties were poor and nonuniform, and the rubber degraded rapidly. It was also difficult to handle, impossible to dry, and contained dirt, flint (from the rock-filled mill used to macerate the shrubs), and vegetable matter. This resinous rubber gave guayule a bad reputation, which still persists in the rubber industry.

Guayule rubber's poor performance was caused by the impurities resulting from inadequacies inherent in the extraction process used, a method that during 40 years changed little from its original design. However, a breakthrough was made in the late 1940s when it was found that resin could be easily removed. Unfortunately, the discovery came too late, no derestinated rubber was produced for commercial use because the guayule program was then being termirated.

Since it is unlikely that the resinous guayule rubber will ever again be marketed, this chapter outlines the properties of guayule rubber purified of resins.

Nonrubber Constituents

Because guayule rubber is extracted from the whole shrub including the roots, dirt and rocks are potential contaminants; so too are cork and bagasse. In the Mexican process for solution-phase purification these are largely removed. Although the sah content recorded in Table 2 is higher than allowed in the best grades of hevea where it was the recorded in the best grades of hevea where it was the recorded in the best grades of hevea where it was the recorded in the best grades of hevea.

There are, however, some beneficial nonrubber constituents in heve rubber that are not present in guayule rubber. These include small amounts of nitrogen-containing materials, notably proteins, amino acids and polypeptides, which accelerate vulcanization and save time for the rubber processor. These are also absent in synthetic polysoprene elastomers and it seems probable that, as in the case of synthetic polysoprenes, compounds can be added to guayule rubber to overcome this lack.

TABLE 2

Nonrubber constituents in a typical sample of rubber produced by the Mexican government at the Saltillo guayule extraction mill

	Guayule	Hevea (SMR-5)
Dirt (percent)	.007	0.05
Nitrogen (percent)	0.16	0.7
Ash (percent)	0.79	0,5
Copper (ppm)	trace	8
Manganese (ppm)	0	10
Volatile matter		
(mainly moisture)	1.0	1.0

^{*}Allowable maximum figures

Chemical Structure

Like hevea rubber, gunyule rubber is a polymer of the simple 5-carbon molecule, isoprene. The isoprene units are joined together end to end to form a giant molecule containing tens of thousands of carbon atoms in a linear chain identical to that of hevea rubber and with similar molecular weight (Figure 5). As a result, guayule rubber has the same stretch, bounce, and general properties as kevea rubber.

Today, the technical requirements of rubber products have become extremely precise. If a few percent of the isoprene units differ from the rest in their geometry, then the rubber can be inadequate for use in tyres and other products used under severe conditions. The geometry and attachment of the isoprene units within a molecule are termed the molecule's microstructure.

Figure 5, Guayule rubber consists of thousands of isoprene units joined end to end (i.e., carbon atom 4 of each is connected to carbon atom 1 of the next. In both guayule rubber and heven rubber all the double bonds have enserged entering the carbon chain at each end, i.e., at carbon atom 2 and carbon atom 3, is connected to the sume side of the double bond).

In collecting data for use in this report, several modern techiques for determining small inhomogeneities in microstructure have been applied to guayule. Nuclear magnetic resonance spectroscopy (proton NMR at 60 MHz and 300 MHz, and Carbon-13 NMR at 25 MHz) have shown that the microstructures of g ayule rubber and of hevea rubber are identical. The instruments could have detected differences if only a few tenths of a percent of the isoprene units were different in the two rubbers.

Within the limits of detection of the sensitive nuclear magnetic resonance measurements every isoprene unit in guayule rubber is attached at its ends and every double bond has ch stereochemistry. They all have the cis-1, 4 shape and attachment. No other type of isoprene structure, (such as trans-1, 4 or 1, 2 or 3, 4 bonded isoprenes) is present. This contrasts with synthetic polyisoprenes, which may contain from 1 to 8 percent of isoprene units that are not cis-1. 4. Although this difference appears small, it affects certain performance characteristics (eghot contain the contained of the contai

The identity of structure between hexea and purified gauyale rubbers is confirmed by infrared and x-ray measurements as well as by differential thermal analysis (DTA). Both rubbers show a sharp break corresponding to the glass transition at exactly the same temperature. Furthermore, if each rubber is first chilled (2 days at-20°C), a high degree of crystallinity becomes apparent in the DTA plots. This only occurs when the microstructure is highly uniform. The hexea and guayale rubbers perform similarly in this very sensitive measurement providing strong continuation that the two have the same structure.

The amount of branching and cross-linking between guayule rubber molecules has not been defined quantitatively, though the ease with which the rubber dissolves in solvent suggests that it is low. Guayule does not appear to be a highly cross-linked species. Little gel is produced during formation of rubber in the plant and little forms after extraction. In fact, the Mexican pilot plant relies on dissolving the rubber in aliphatic solvent as a step in the purification process.*

Mechanical Properties

A summary of the mechanical properties of guayule rubber that shows the similarity to the properties of hevea rubber is given in Table 3.

TABLE 3

Properties of Raw Guavule Rubber

	(Guayule*	Heven MR-5)
Mooney Viscosity (ML-1+4		
at 212°F/[100°])	105	85
Antioxidant (percent BHT)	0.6	
Acetone solubles (percent)	2	2.8
Wal'ace Rapid Plasticity (Po)	47.5	
Plasticity Retention Index (percen	(t) 41	60
Tack**		
Rubber to rubber (psi)	9.5	8.5
Rubber to metal (psi)	4.25	5.0
Rubber-black masterbatch (psi)	8.25	11.5
Rubber-black masterbatch		
to metal (psi)	5.25	4.0
Green Strength (psi at 100 percen elongation) 20	t ±0 05 20	±0.05

*These figures are based on early samples from the pilot plant at Saltillo, Mexico They are likely to change as the extraction and purification methyds are refined.

**Determined using a Monsanto Tel-Tak apparatus. Table

The Mooney viscosity, which tests the "plasticity" of a rubber, has been measured at 95-105 in modern guayule samples. This is in the same range as hevea rubber's plasticity and means that guayule rubber should not exceed hevea rubber in the amount of softening needed during milhing. But guayule rubber, like hevea rubber, will probably be more difficult to process than synthetic isoprene-type rubbers.

The plasticity-retention index is an indication of a rubber's resistance to aging or breakdown. Although the guayule sample tested fell short of the standards of the highest quality hevea rubber (ie., SMR-5 where PRI is about 60), it is in the range of the hevea rubber used in tires (SMR 20, whose PRI is about 40).

"Green strength" measures the strength of the raw rubber during processing. Without good green strength, a tyre hung on a hook during manufacture will sag out of shape before valeanzed. Indeed, a primary reason why synthetic polyisoprenes are not more widely used is because their green strengths are interior to that of hevea rubber. Imperfections in the microstructure are believed to be a major factor contributing to reduction in the green strength of a polyisoprene rubber. However, as can be seen in Table 3, guayule rubber's green strength is equivalent to that of hevea rubber.'

^{*}Panel member E. Campos Lopez reports that the gel content (a measure of branching and cross-linking) is never more than 4 percent (measured in cyclobexane), and that it does not increase upon standing.

The similarity of microstructure is expected to result in similar green strengths between the two rubbers. But comprehensive analyses between that of synthetic polysionceae and hexes rubber. If this proves to be a true feature of guardle rubber (and not just hat of early samples from a new pilot facility) is might limit the percentage of guardle that would be added to the blend of

"Building tack" measures how well the layers of raw rubber stick together before they are vulcanized. It is a very important property in the fabrication of certain types of tires. Synthetic elastomers have less building tack than hevea. Both hevea and guayule rubber have good building tack than do not require the addition of ingredients to increase tack. The excellent flow and tack characteristics of guayule rubber should make it suitable for the manufacture of radial tries and large tires.

Processing Characteristics

Because of its structural similarity to hevea rubber, no difficulties are expected in processing guayule rubber with standard equipment. For example, it softens readily (see Figure 26) and is expected to extrude readily and flow properly in molds. Guayule rubber differs slightly from heven rubber in the ratio of chemicals needed to compound it for adequate cure rates. This is due to the slightly different nonrubber impurities expected in commercial products. Both contain small amounts of moisture, dirt, terpenes, and triglycerides, but guayule lacks the protein "impurity" that is beneficial to the curing properties of heve arubber.

Comparative data on vulcanizates of guayule and hevea rubber are given in Table 4. A

TABLE 4

Properties of vulcanized guayule rubber*

	Hevea (SMR-5)	Guayule
Inititial Viscosity (lbsin.)	5.5	5.0
Minimum Viscosity (lbsin.)	4.0	3.7
Maximum Viscosity (lbsin.)	35.0	25.0
T. s. min.	7.0	10.5
T., (90), min.	90.0	25.0
Cure Rate (lbsin./min)	5.3	2.5
Cure time at 284°F (140°C), m	in. 19	25
Modulus at 300 percent (psi)	1,770	1,050
Modulus at 500 percent(psi)	-	2,455
Tensile Strength (psi)	4,050	3,645
Elongation (percent)	490	635
Set at Break (percent)	13	14
Bashore Rebound (percent)	48	40
Shore A Hardness	60	54
Swelling Index (g. benzene		
imbibed/g. rubber)	2.94	4 3.44
M.	9,500	13,000
Tear Strength (ppi)	436	178

Vulcanized using recipe 2 A given in ASTM D 3184-71. The vulcanization characteristics of each stock were determined on a Monsaint Rheometer at 284 F (140°C) using ASTM D 2084-71 T. Measurements courtesy of H. L. Stephens.

rubbers used for tyre making by large manufacturers.
Green atrength is important only during fabrication (ie, before vulcanization): It does not affect the quality of the final manufactured product, and it is important only in large factories that use sophisticated automated methods.

standard formulation developed for comparing hevea rubbers was used. The results show that guayule's lack of vulcanization accelerators cause it to vulcanize more slowly than hevea rubber. By adding accelerators to the formulation this can undoubtedly be overcome.

Performance

Almost nothing is known of guayale rubber's performance under full operating conditions. Virtually all the 120,000 tons of resinous rubber, purchased by rubber companies between 1903 and 1946, were blended with hevea rubber and may have been used as much for its tackiness as for its rubber.

While the federal guayule project, was winding down in the early 1950s, several tons of deressinated guayule rubber were distributed to industry for performance testing. The results were erraintic (not always attributed to the rubber) but in a federally supervised test. Firstenor Tire and one hevea tire on the back wheels of three gravelladen trucks. To ensure equal wear, the tires were swiched regularly. The guayule tires performed as well as the hevea tires. One survived 50,900 miles (32,000 km) without showing a body break (see Figure 6).

If production were resumed and guayule sought a place alongside heven and the synthetic polysoprenes in tire manufacture, it is likely to be used-initially at least—in blends with these rubbers and with the more widely used styrene-butadiene synthetic rubbers. Under such circumstances, slight differences from hevea in processing or properties become much less noticeable, a factor that could greatly facilitate commercial introduction of guayule.

6 Economics

Because no guayule has been produced commercially in recent decades, its economics are very uncertain. The available data are largely irrelevant and reflect wartime conditions of 30 years ago. They are based on obsolete production methods, on a low-quality resinous rubber, and do not take into account the potential sale of by-products. Nonetheless, some general conclusions and the production of the produc

General Rubber Market

In a recent analysis* the World Bank projects

*World Bank, June 1976, Price Prospects for Major. Primary Commodities. Report No. 814/76, Commodities and Export Projections Division.



Figure 6. This—the first successful truck tyre ever built of guayule rubber—was made from rubber grown and processed by the U. S. Natural Rubber Research Station, Salinas, California. Carcase construction is 100 percent guayuler urbber with tread made of synthetic rubber. Road tests, in which the tyre was run continuously at 45 mph with approximately 40 percent overload, were made by the Olimber Rubber Reserve, Camp Bullis, Ievas, Guayule proved to be the equal of between rubber and the States. This tyre, one of a test lot, was fabricated in 1953 by the Firestone Tyre and Rubber Company, Akron, Ohio. (U. S. Department of Agriculture)

that until the end of this decade the worldwide demand for rubber-both natural and syntheticwill grow at the rate of 5 percent per year. Furthermore, natural rubber is expected to retain its present share (30 percent) of the total rubber market.

In the past, growers have been able to increase production of hevea rubber to match increases in demand. During the 1960s, hevea rubber production increased at a rate of 3.9 percent per year. Because of recent breakthroughs that raise the yield per tree, the rate is expected to rise to 5.7 percent annually for the rest of this decade. However, yields cannot be increased indefinitely, and between 1980 and 1985 the world's supply of hevea rubber is expected to increase annually by only 3.8 percent. This is a serious concern, because during these years the world's rubber requirements are projected to grow annually by 5.9 percent. Thus, the World Bank concludes that after 1980 hevea rubber cannot retain the share of the market that it now has. Not enough will be produced and a shortfall will result. The

probability of such a shortfall has also been reported by the Malaysian Rubber Bureau (see Figure 7).**

Worldwide recession depressed prices for the different grades of hevea rubber by 23 percent in 1975. But the World Bank expects prices "to increase (in current US dollars terms) to about 60 US cent per lb. [§ 1.32 per kg] in 1980 and 78 US cent per lb [§ 1.72 per kg] in 1985." The current price is 39 US cent per lb [86 cent per kg].

The projected shortfall of hevea rubber and the large price increases expected during the 1980s provide economic incentive for urgent action to develop guayule once more into a commercial

Synthetic Elastomers

Synthetic rubbers derive from the petrochemical industry. All but one-polyisoprene-have structure and properties different from natural rubber.

^{**}Allen, Thomas and Sekhar. See Selected Readings.

Because of this, they are not always interchangeable with natural rubber in the major rubber products such as tyres and industrial conveyor belts, where small differences in properties can be important.

With the petrochemical industry's rapid expansion in recent decades, synthetic rubber producers were able to increase their supplies rapidly. This was made possible by the seemingly unlimited supplies of petroleum—an assumption that has been shattered by the recent "energy crisic".

Petroleum's ready availability during the 1960s led to a drastic lowering of the prices of monomers (the "building blocks" from which synthetic arbbers are constructed), which was reflected in a sharp decline in synthetic rubber prices. Today the petroleum situation is much different, and it seems likely that petroleum prices will continue to rise in the future, increasing monomer prices and raising synthetic rubber prices.

Man-made polyisoprene and hevea rubber can be interchanged for some purposes. However, in the United States, it is produced by only two facilities whose annual production is only about inported each year. Isoprene is expensive and, with petroleum prices increasing, its price will rise. These "synthetic natural rubbers" have been 3-4 cent per lb (7-pent per lbg) more expensive than hevea rubber-a prenium that was paid by industry because they were more uniform and more easily masticated (the "softening up" that is usually the first step in the manufacture of rubber goods).

Tyre Rubber

Seventy percent of the heves rubber imported tyres; the remainder is used to manufacture tyres; the remainder is used in lates products, in industrial conveyor belts and hoses, and in footware (Table 5). The elasticity, resilience, tackiness, and low heat buildup that products are important in tyre carcasses. Because rubber are important in tyre carcasses. Because rubber are ratined a strong market in face of competition from the synthetic elastomers that are not polysioprenes.

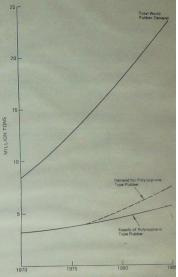


Figure 7. The shortfall in rubber production projected for the 1980s if present growth rates continue. Based on model calculations by the Malaysian Rubber Research and Development Board, which predden the Research and Development Board, which predden the research and Development Board, which predden the research and the project of the research and the project of the rubber required. The supply of polysoprene-type rubber is projected to increase at only 4 percent annually. Taken from Alfen, Thomas and Schlar. See Schlert Researches.

The market strength of polyisoprene rubbers is due to these technical qualities. Because the differences in quality derive from fundamental structural differences between polyisoprenes and the other polymers it seems unlikely that some technical improvement will change the competitive position of polyisoprene rubbers, at least in the near future.

The larger the tyre, the higher the proportion of natural rubber it normally contains. Aircraft tyres are made almost entirely of natural rubber;

[&]quot;It is possible that synthetic polyisoprene use could grow substantially in the future. Synthetic polyisoprene has some some some some some some some some recomment, which is manufactured from performers and evirutives. Historically, the U.S. petrochemical industry has cracked natural gas or light feedbond and the obtain raw materials. New pophsha or gas oil sed good ounder construction. Or aphitha or gas oil yield isoprene as a by product and the cost of by-product isopenee could be much less than the currently deliberately manufactured isoprene.

truck and bus tyres contain at least 40 percent; automobile tyres—which absorb the bulk of the natural rubber produced—contain about 20 percent. Radial tyres, which are taking an increasingly large fraction of the automobile tyre market require almost twice as much natural rubber as the older tyre designs.

It seems likely that, in the United States at least, higher petroleum costs will increase the number of small, light cars and decrease the tyre market's growth. However, the growing use of radial tyres should produce additional demand for natural rubber, even though they are long-wearing.

TABLE 5

Estimated natural rubber consumption in the United States, 1973 (1,000 Long Tons)

Product	Consumption	Percen
Passenger car tires	192	26.6
Truck bus tires	310	42.9
Other tires	50	7.0
Total for tires	552	76.5
Footwear	15	2.1
Hose and belting	30	4.2
Other fabricated goods	85	11.8
Other products	40	5.4
Total	722	100.0

Information courtesy of D. H. Blank.

In other countries a greater rate of increase in the numbers of motor vehicles should create relatively greater increases in natural rubber consumption than in the United States.

Wild Stands of Guavule

The Government of Mexico has recently surveyed its wild guayule and charted over 10 million acres (4 million ha) of accessible, dense stands of native bushes suitable for commercial harvest. Averaging 10-17 percent per bush, it is estimated that these stands contain a living stockpile of 300,000 tons of guayule rubber. It has been judged economic to exploit this commercially, especially because the region is arid and largely unproductive; guayule promises jobs and income for many poverty-stricken peasants.

In the United States, native guayule stands are too small, and wage rates too high, for wild guayule to be a profitable rubber source. Thus, for the United States—and all countries outside Mexico—it must be developed as a cultivated crop.

Cultivated Guayule

Rubber yields have been measured only for a

few guayule strains originally selected by W. B. McCallum, a guayule pioneer and chief scientist of the Intercontinental Rubber Company, Virtually all the guayule grown during World War II was based on McCallum's seeds (especially on a strain listed as Number 593). The vast wealth of guayule germ plusm in the wild lies untapped.

The best yields yet reported* for cultivated guayule were from plants directly seeded in irrigated fields at Salinas, California. Two years after planting they yielded 1,200-1,500 lb of rubber per acre (1,300-1,700 kg per ha).

Using the more common method of growing seedlings and transplanting them to the field, rubber yields of 900 lb per acre (1,000 kg per ha) after 2 years were usual during World War II.† Generally, trigated guayule will accumulate about 500 lb of rubber per acre (560 kg per ha) annually over a 3-to 5-year period. (Guayule plants continue to accumulate smaller amounts throughout their lifetime, and a single harvest of 27,000 lb per acre (30,000 kg per ha) has been recorded.§)

These yields compare favorably with hevea rubber yields before World War II when, in Southeast Asia, for example, 16-year-old rubber trees produced about 200 lb of rubber per acre (340 kg per ha) annually.‡

The Rubber Research Institute of Malaysia has improved Hevea yields dramatically since that time, and in 1974 Malaysia's average annual rubber yield was 1,200 lb per acre (1,300 kg per ha). Trials have shown that, by using special techniques, 3,000-6,000 lb per acre per year (3,400-6,700 kg per ha per year) are possible. Guayule has far to go to match these figures.

Production Costs

To complete with hevea rubber prices, guayule production in the United States must be mechanized. Wages in hevea rubber producing areas are about 20-30 cents per hour, while the minimum agricultural wage in the United States is \$2.00 per hour. Fortunately, guayule is suitable for mechanized agriculture. Hevea on the other hand, is one of the most labor-intensive crops in the world. No method for orcopping it mechanically has been devised, and rising labor costs may

^{*}A. C. Hildreth. 1946. Recent advances in guayule growing, India Rubber World 114: 55-59.

tPoage, W. R. 1945. Study of Rubber in the United States, Mexico and Haiti House Report # 2098, January 1945, 78th Congress, 2nd Session.

^{\$}The highest production rate ever recorded was a small experimental plot that produced over 100 ib of rubber per acre per month (over 100 kg per ha per month) during the second year of growth.

tVan Iterson, G. 1936, 37. Hevea brasiliensis as a producer of rubber. Indian Rubber Journal. 92: 869-73 and 93: 23-30, 60-65.

well affect its profitability in the future. During the ERP period, it was found that the season when labor was needed in California's guayule fields corresponded to the slack season for most farm workers. Thus, guayule helped provide them with year-round employment.

The United States contains huge areas of land that appear suited to guayule cultivation. It has been estimated that, in theory, there is ample land in Texas and the Southwest to grow enough countries to fill the nation's annual rubber needs.

Although costs for producing guayule rubber today are uncertain, it would appear that no exceptional costs are involved for planting, cultivating, and harvesting the crop. Indeed, the costs are likely to be much like those of the same operations on other crop plants. The uncertainties lie mainly in the milling costs. The costs of milling in the 1940s are irrelevant today, but the Mexican government's plot-sized mill should soon give a better idea of modern costs. Although the new mill simplifies several of the previously used steps, it does require solvent to deresinate the rubber and solvent will be lost in each step. Moreover, the water needed in the flotation method used to separate rubber from pulped shrub may prove costly in and areas.

An advantage of guayule is that it can be left in the ground without losing its rubber. The plant can be viewed as a living and growing stockpile, which, once established, requires little or no management or care and provides an economic "cushion" For example, the Intercontinental Rubber Company sold no rubber from 1931 to 1933 when rubber prices were disastrously low. They allowed the "stockpile" to grow and used it only when prices rebounded.

For the same reason, guayule may be an excellent crop for marginal semiarid regions on the fringes of conventional agriculture. It is a hardy plant and will survive drought for several years. Although it may not grow as vigorously, no rubber will be lost. It therefore offers a security that other crops cannot.

The ability to survive and accumulate rubber without maintenance may make guayule an excellent crop for stopping soil erosion, and even for grazing—both of which are important for increasing the productivity of semiarid wasteland. In and regions with 8-14 in. (200-350 mm) annual rainfall, the conventional measures of yield per acre per year may be irrelevant. A guayule crop acach 7 years may be preferable to no crop at all. This is the essence of the Mexican program, in which each wild stand will be harvested on a 7-year rotation and left to reseed itself between harvests.

By-Products

Guayule's by-products have never been capitalized on commercially. Indeed their composition and qualities are little known. Yet some seem to promise new importance. The wax from guayule leaves has a remarkable hardness and a melting point even higher than carnauba wax (generally acknowledged to be the best wax available). It is produced in large quantities by the leaves, appears easily extracted, and has a clear, white color that carnauba cannot match. With some grades of carnauba wax selling at over \$2.00 per lb, guayule wax could become a financial asset to the processor.

Similarly, the mill's bagasse and cork appear to have commercial significance, though final analyses of their value for paper, cardboard, or construction materials are not yet complete.

The resins too may have commercial value. Although their structure is not known with certainty, they do contain some of the same terpenes produced by paint some of the same terpenes acids—often in dorr surply—are used for sizing in the paper industry, and volatile terpenes are the important in the major time dustry. All the production is the production of the production

War Against Black Rubber

The Rubber Board has unleashed a relentless war on black rubber hoarded by traders in different parts of the Country. Sizable quantities of natural rubber are being moved to the form Kerala and Tamil Nadu by a certain section of the rubber traders defying the for inter-state transport of rubber. All modes of transportation including railways and and parel services are being used to transport black rubber.

A surprise raid conducted by the Inspecting Squad of the Rubber Board in the premises of a few leading rubber traders in different parts of the country has revealed huge quantity of unaccounted rubber. Incriminating documents have also been seized from these traders. In view of the gross malpractices rampant within the trading community, the Rubber Board has constituted special squad to perform surprise checks within the camps of all suspicious traders and at strategic check posts to unearth all the unaccounted stocks. The black rubber so hoarded had upset the rubber market operations in addition to causing huge losses to the national excequer by way of cess evasion.

It has also been decided to spot out those rubber goods manufacturers who do not have valid licenses for procuring rubber and to recommend to the respective State Governments to disqualify them.

Conference **Aubbar**

Following is a detailed account of the deliberations of the 'Rubber Conference held at the main-committee room of Parliament House Annexe at Delhi on 9th January 1979 convened by the Union Ministry of Commerce. Shri. Mohan Dharia, Union Minister of Commerce addressed the meeting. Rubber producers, traders, rubber goods manufacturers, central and state authorities attended the national meeting which discussed all relevant aspects of rubber prices and its impact on national economy.

Mr. Mohan Ditaria, Union Minister of Commerce revealed that the revised prices for various grades of natural rubber would be announced by his ministry within one month. He also added that suitable machinery to ensure realisation of the statutory prices by the ultimate producer would be deviced, so that the producers do not have to undersell their produce in distress in times of bountiful arrivals in the market.

Mr. Dharia who was addressing a national meeting of rubber producers, traders, rubber goods manufacturers, Central and State authorities associated with the rubber industry (at the Main Committee room of Parliament House Annace) at New Delhi on 9-12-79, disclosed the intention of the Union Ministry of Commerce to constitute a (consultative) committee comprising of representatives of the Commerce ministry, Industry ministry and the Rubber Board to device measures for maintaining stability in the rubber market. This committee will be authorised to formulate recommendations in consultation with rubber producers, traders, rubber goods manufacturers and respective state governments who have rubber interests, on such matters like rubber imports and exports. No unilateral decision would be taken, the Minister assured, without consulting the concerned interests.

Higher Production

Mr. Dharia called for intensifying production from existing rubber plantations and planting rubber in new areas wherever available. He pointed out the necessity to boost rubber production in a big way in the country for which the Government of India would earmark suitable financial allocation. Unless this is done, the Minister anticipated, the rubber based industries in the country will have to starve for this vital raw material.



Shri Mohan Dharia calls for intensifying production from existing plantations

The activities of the Rubber Board, the Minister felt, will have to be revitalised and strengthened in order to attain the projected production of raw rubber. Any new schemes for augmenting production the Minister observed, would be

For ensuring availability of stocks within the country, Mr. Dharia suggested that if the flow of rubber could be properly managed, it should be possible to get along with three months stock instead of four months. The rubber goods manufacturers, the Minister observed, should try to manage with minimum stocks. For streamlining the second of the secon the process, Mr. Dharia pleaded for maintaining accuracy and reliability in the statistical estimates.

Referring to rubber prices, the Commerce Minister argued the necessity to ensure a remunerative price to the rubber producer as otherwise, he will lose interest and switch over to other crops like Cocoa. Rubber production should be enhanced to reach a stage where the country can afford to export a sizable quantity to the world market and meet the increasing international demand. At the same time the rubber plantation industry should try to stay as a competetive enter-prise, so that the prices do not shoot up above international level and create instability. This would ensure availability of raw rubber to the consumers at reasonable price.

"Are we short of rubber now?". Mr. Dharia asked? "We are. That is why imports became necessary". The Minister remarked that he was not in favour of imports at all, but it was necessary to take care of the needs of the rubbergoods industries. industry.

Rubber Imports

Last time imports were ordered when prices ruled above Rs. 11.00 for a Kg of rubber. The State of Kerala has the biggest stake in Natural Rubber in India as the economy of that State is rubber. When there was a crisis of shortage for natural rubber, though the Government of Kerala assured to make available the rubber, the experience was really sad. On that score, the Govern-ment of India even deferred the decision to import

Mr. Dharia observed that it was justifiable if prices went up in lean months. "But how it happened when production was in full swing?" That could be only due to the scarcity of the commodity, he pointed out.

The Minister while concluding his opening remarks sought the view points of the representatives of various interests present at the meeting, where one after the other gave their views.

C. Prabhakaran

Mr. C. Prabhakaran, representing the United Planters' Association of South India and the Association of Kerala attributed the reasons for shortfall in rubber production in 1978–79 to the vagaries of nature which prevailed for 4 to 5 months and the laboru unrest in large plantations which lasted for 2 weeks. He cited that the low representing the properties of the programs uses madewhich lasted for 2 weeks. He cited that the row prices ruled for rubber in the previous years made the producers neglect their holdings resulting in poor maintenance and reduced output. Now that the prices had improved, rubber estates would be better cared and production also would pick up, Mr. Prabhakaran observed.

In response to the questions of the Commerce Minister to spell out as to what should be the remunerative price for natural rubber, Mr. Prabhakaran replied that it is an issue to be discussed in detail and finalised

Mr. Mac In Tyre

Mr. Mac In Tyre representing the Automotive Tyre Manufacturers Association (ATMA), said that it is essential to have a reasonable price maintained for natural rubber for the welfare of both the producer and manufacturer. In times of scarcity he felt, imports must be allowed. Then only an uninterrupted supply can be ensured.

He pleaded for the import of a further consignment of 20,000 tonnes of natural rubber to restore normaley in rubber supply. On behalf of the consuming sector Mr. Mac In Tyre expressed willingness to participate in a consultative committee with growers and arrive at an agreement on all issues of dispute.

D. S. Kulkarni

Mr. D. S. Kulkarani, Editor, Rubber News representing the All India Rubber Industries Association, said that the rubber growers should try to produce as much rubber as thery can and get a good price. They should also ensure supplies in adequate quantities. Mr. Kulkarni pointed out that the rubber plantation industry was consistantly registering a steady growth and that it is only this year it dropped. To have a clear idea of the rubber position in the country, it is necessary to constitute a committee, having representation for various interests, which should review the demand and supply position once in three months.

Mr. Kulkarni estimated the deficit till date as 32,000 tonnes. Out of this, 15,000 tonnes have already been imported. The remaining 17,000 tonnes should be imported with immediate effect.

Mr. Kulkarni discussed the shortage felt for synthetic rubber and pleaded for establishing a third synthetic rubber plant in the country. In India the proportion of NR:SR consumption is 70–78%; 22–23% while the global pattern is 70–75%; 25–30%. India should try to revise its SR-NR consumption rate to 40:60, which could be achieved by enhancing the capacity of the existing units and licensing new ones.

Mr. Kulkarni then made out a case for restructuring of the Rubber Board in order to increase the proportion of representation for the rubber goods manufacturing industry on that Body. He pleaded for parity of seats in the Board with growers.

Land prices in Kerala, Mr. Kulkarni pointed out, is as high as Rs. 30,000 to Rs. 50,000/- an acre. Encouraging rubber planting at such costly land needs rethinking, he felt. Therefore rubber should be introduced to other areas in the country enjoying ecological conditions suitable for rubber growing.

Joseph Monippally

Mr. K. Joseph Monipally, General Secretary of the Indian Rubber Growers' Association and



Shri SG Sundaram IAS Chairman, Rubber Board being introduced to Shri George Fernandes by the Commerce Minister Shri Mohan Dharia



The representatives of State and Central Government in rapt attention.

member of the Rubber Board pleaded that the shortfall in rubber production was caused on account of the poor maintenance of rubber holdings resultant to the very low prices prevailed for the last 3-4 years. Only 30%, of the growers have been resorting to spraying their holdings. Unless proper spraying is done the crop would go down by even 50%.

Now that the prices were fairly good, producers were maintaining their holdings well which would ensure a bumper crop.

Mr. Monippally appealed to the Government to stop further imports of natural rubber and to keep the stock already imported as a buffer stock. He suggested levying some duty on imported

If an incentive price is ensured, adequate quantities can be produced domestically. He also referred to the memorandum submitted by him to the Union Minister of State for Commerce Shri, K. K. Goyal when he visited Kerala, wherein he had argued the whole case of the growers. The points raised there may be considered while fixing

B. L. Sahney

Mr. B. L. Sahney, Joint Secretary of the Small Tyres Manufacturers Association asked why prices did not come down even after imports. If there is ample rubber as contended by the producers how the prices could rule so high? According to him the deficit is 42,000 tonnes. The Government should import rubber and keep as buffer. Imports should be stopped when normaley for availability of rubber was restored.

When natural rubber is in short supply there is scarcity for synthetic rubber also. Synthetic rubber sale also should be controlled by government.

The excise duty on natural rubber levied from manufacturers, he argued, should be stopped in view of the fact that crores of rupees have accumulated with the Government.

George Fernandes

Mr. George Fernandes, Union Minister for Industries, intervening in the discussions, said that he thought the growers would spell out the price they deem reasonable. The problems faced by the growers, the Minister felt, could not be related to

Mr. Fernandes was surprised the way rubber production fluctuated and dropped. The Automotive industry he said, was growing at a fast rate. The output of tractors have gone up by 50% while that of commercial vehicles by 30-40%. A higher rate of growth has been targetted for the next year, he said.

The production of natural rubber in the country, the Minister pointed out, should keep pace with our requirements. In this bid he did not consider the augmentation of production of synthetic rubber as probable solution. The technology evolved and adopted in Western Countries may not suit us as the problem in India is essentially one of unemployment.

The Rubber Board, Mr. Fernandes suggested, should interact with the producers and increase production of natural rubber. The need of the Tyre Industry for raw material should be fully

met. Then only the wheels of industry can be kept moving.

Referring to tyre prices, the Minister warned the rubber goods industry that they should not get away with the feeling "all is well". The increase in tyre prices made recently, the Minister felt, a substantial part of it is unjustifiable. The entire pricing pattern in certain sectors, Mr. Fernandes, pointed out has been exhorbitant. The increase in tyre prices was more than the proportionate rise in rubber price.

The producers and consumers have problems which could be set right through mutual consultation. The problems of the small scale rubber based industries are still genuine. Shortage and high prices of rubber had hit them badly.

Joseph Maveli

Mr. Joseph Maveli, who participated in the discussions representing the Janatha Karshaka Sangam, said that the cost of production of rubber in Kerala is high, because of the high cost of inputs. He pleaded for a price of Rs. 1000/- per quintal for RMA-5 grade rubber and Rs. 1200/- for RMA-1. He requested the manufacturers to agree to this price.

Mr. Maveli drew the attention of the house to the high prices of finished rubber goods. He argued that the prices of finished goods also should be fixed. The farming community should be given all encouragement consistant with the policy enunciated in the manifesto of the Janatha Party. At this stage Mr. Mohan Dharia intervened and asserted that the Government will have to take recourse to the enforcement of Essential Commodities Act if the finished rubber goods are not sold at reasonable prices.

P. K. Vasudevan Nair, Chief Minister, Kerala

Mr. P. K. Vasudevan Nair, Chief Minister of Kerala, who represented his Government thanked the Commerce Minister for convening such a meeting. He expressed his concern in the delay in refixing a remunerative price for natural rubber. The Members of Parliament from Kerala had raised this issue on the foor of the Parliament on several occasions.

The State of Kerala accounts for the bulk of natural rubber produced in the country. There are over 1,20,000 small growers of rubber in Kerala who produce over 60% of the total output of rubber. The pricing policy of the Government of India for agricultural commodities, Mr. Vasudevan Nair observed, was to encourage primary producers.

The Tariff commission had held an enquiry as early as 1968–69 and brought out a report in 1970. Based on that a price of Rs. 520/- per quintal was fixed. In the absence of a mechanism to enforce this statutory price for months together producers had to undersell their produce in distress. This is a major issue which the Government should take note of, the Chief Minister said.



Kerala's Chief Minister pleading for a remunerative price



A view of the participants. Shri CM Stephen, Leader of the Opposition in Lok Sabha is seated in the front row

The producers have been pressing for a revision of the rubber prices since then which was heeded to after many years when the Government made an ad hoc revision to Rs. 65½- per quintul. This was not at all a proper revision. There was no element of incentive in the new price. Therefore the production declined, productivity dropped and the average yield went down to 680 Kg per heetare from 710 Kg.

The Rubber Board has done a great deal of good work in enhancing rubber production in the country. Despite the Board's attempt the producers were indifferent towards proper maintenance of their holdings for want of an incentive return.

In view of the fact that a combination of coconut with cocoa is highly paying, it is likely that many growers may replace their rubber with this new combination.

To get over these hurdles, revising rubber prices based on an objective cost study is the only solution. Also it is adequate if the former cost figures are updated, The Chief Minister suggested.

He made it clear that by remunerative price, he did not mean a very high price. for he was aware that unusually high prices would make it obligatory for further revision of wages. In 1978 itself, the wages of rubber plantation workers were

Producers, the Chief Minister pointed out, should not ask for a price the industry could not afford.

Referring to the demand of Mr. D. S. Kulkarni to increase the domestic production of Synthetic between Mr. Vasudevan Nair said that this is a point to be given deep thought and discussed with the producers so that they can also plan therifuture course. 75% of the small growers are having rubber area requiring immediate replantation. If these areas are replanted using high yielding materials there is immense scope for increasing fordouction.

The Chief Minister then drew attention to the morphone of the self-sed that the rubber component was costed at the highest price prevailed while fixing prices of tyres but it was never brought down when rubber prices came down. Some how a total discipline has to be brought into the whole system, the Chief Minister suggested.

Referring to imports, the Chief Minister said that, there is no necessity for it now. Cost wise there is no attraction on imported rubber. If the government fix a duty on imported rubber no body will ask for imports at all.

C. M. Stephen

Mr. C. M. Stephen MP, Leader of the Opposition in the Loka Sabha, who agreed with the Chief Minister of Kerala, said that a large number of small holders and a large number of workers are dependants on rubber plantations. Pricing of natural rubber, should be viewed in the larger national context. Pricing policy shold be coined with a long term perspective consistant with the national commitment for self reliance and self sufficiency.

The production pattern of natural rubber is not discouraging. In less than 2 decades with a meagre 25,000 tonnes in 1906–61 the production steadily rose to 1,50,000 tonnes in 1976–77. We should try to ascertain as to how this was achieved. No doubt, it is through sheer hard work.



Another view of the participants

The small holdings sector of the rubbr plantation industry has been passing through a period of agony for want of a remunerative return. When we talk of a deficit now, it would be worthwhile to examine how the manufacturing industry behaved when there was a surplus. They refused to keep adequate stocks.

What is the case for additional imports now? Is it that adequate rubber is not available at reasonable prices. Mr. Stephen asked? If a surplus is created by imports, the economic equilibrium will be upset. This will discourage the small holder resulting in a total collapse of the

The coconut-cocoa combination can certainly yield more income than rubber and it is likely that the producers may shift to adopt this new crop pattern replacing rubber.

To act as lever in times of crisis, a buffer stock of natural rubber should be raised. There is no justification in fixing a price for natural rubber lower than the international rates.

V. I. Chacko

Mr. V. I. Chacko of United Planter's Association of Southern India pleaded for a remunerative price for natural rubber if it is to act as a stimulus for increasing production. Otherwise marginal producers would shift.

Mr. Chacko then explained the efforts being made by him to negotiate with the rubber consumers to evolve a mutually agreeable price formula, for natural rubber. As the negotiations are only half way through and as the response is good, Mr. Chacko requested for a month's time to

present the consensus to the Union Commerce Ministry.

M. M. Jacob

Mr. M. M. Jacob, Prerident of the Kerala State Co-operative Rubber Marketing Federation and Member, Rubber Board who intervened in the discussions appealed to the Commerce Minister to consult the rubber producing interests also before arriving at decisions on imports.

Mr. Jacob suggested that 15,000 tonnes of natural rubber should be kept as a buffer stock. The Government also should adopt a price band within which the prices can be allowed to swing. When the prices go below the band, some agency should enter the market and procure rubber till prices get in to the band. Also when prices cross the upper limit of the band, the procured rubber should be released to bring back the price within the band.

Mr. Jacob attributed the decline in production this year partly to the non-availability of the yeld stimulant 'ethrel'. He also pointed out that as the prices have improved now, producers have started earing for their holdings as could be seen from the spurt in fertilizer consumption.

Estimating the average yield from small holdings at 680 Kg per hectare, Mr. Jacob calculated the cost of production of rubber at Rs. 12.13 per Kg taking into account a 11% interest on the capital invested.

He pleaded for fixation of a fair price based on this for all grades of rubber. He found no justification for imports at the moment.

PK NARAYANAN

The NR production projections presented here are simply aimed at quantifying the output norm that is likely to materialise in 1980, 1985 and 1996 on the basis of what is known about existing acreage, age, structure of existing trees; yield profiles and likely rates of replanting and new planting in the major producing countries. The norm projections are not, therefore based on very specific price assumptions.

"THE WORLD RUBBER ECONOMY:

STRUCTURE, CHANGES, PROSPECTS,"

a joint study by the world Bank and the Food and Agriculture Organisation (FAO) of the United Nations published in June 1978.

The Commodities and Export Projections Division of the World Bank and the Commodities

and Trade Divisions of FAO were primaril involved in the design and implementation

of the study

The authors are Mr. Grilli (IBRD),

Mr. Bennett-Agostini (FAO)

and Mrs. 't. Hooft Welvarrs (Consultant to IBRD).
For the study they did field work in all the

major rubber consuming and producing countries

. . .

Natural Rubber Production Projections

The NR production potential between now and the end of the next decade is to a large extent predetermined by the yield profile of the trees that are already being exploited. Rubber trees planted during the first half of the 1970s will come into bearing towards the end of the current decade and will reach a maximum yield towards the end of the next decade. Action that will be taken with respect to new planting and replanting of existing trees during the remainder of the 1970s will have—in terms of incremental production—only a limited impact on world NR output in the second half of the 1980s. Its full impact will be felt in the mid-1990s.

Under such circumstances, the NR production projections presented here are simply aimed at quantifying the output norm that is likely to materialize in 1980, 1985 and 1990 on the basis of what is known about existing acreage, age structure of existing trees composite yield profiles and likely rates of replanting and new planting in the major producing countries. The norm projections are not, therefore, based on very specific price assumptions: they simply assume

that NR prices will remain high enough to ensure continuous tapping of existing productive trees and a moderate use of chemical stimulation on relatively old trees. (1) Obviously, depending on the price trend, both the intensity of tapping and the use of chemical stimulants can be varied and the actual output trend can correspondingly deviate from the projected norm.

The production norm was derived individually for all the five major (2) and the eight smaller producing countries. (3) The best information available to both FAO and IBRD was used in making the output projections. In the cases of Malaysia, Thailand, Sri Lanka and the couptut was derived from specific information about areas under rubber, age distribution of trees, yield profiles and assumptions about rates of replanting, likely new planting and use of chemical stimulants. In the case of Indonesia and the smaller producing countries, the production projections are based on a much less rigorous model. They contain a larger element of judgment, even though past trends, national plans and country-specific information were considered to the maximum extent possible.

Table A: NATURAL RUBBER - PRODUCTION, 1955, 1960, 1976 (Actual) and 1980, 1985, 1990 (Projected)

	1985-90 1976-90	1	3.8	3.6	1.9	7.9	1.8	2.9	3.7	9.1	9.7	5.1	10.4	4.0	-
	1985-90	(m	3.1	2.4	1.7	7.7	1.1	1.9	2.7	4.4	3.7	2.7	5.9	3.2	
	1980-85	-(% per annum)	3.6	3.7	1.9	7.8	0.5	1.0	3.4	9.2	10.8	7.0	8.4	3.8	-
Gr	1976-80	%)	4.8	5.1	2.0	8.2	4.3	6.4	5.3	15.1	16.1	5.7	18.9	5.1	
	1955-76	l	3.1	4.1	9.0	5.3	2.3	9.3	3.6	8.0-	-3.3	1.4	1	2.9	
	1990	1	5,875	2,700	1,100	1,140	195	220	520	260	120	40	100	6,135	-
Projected	1985		5,035	2,400	1,010	785	185	200	455	210	100	35	75	5,245	
	0861	ns)	4,215	2,000	920	540	180	190	385	135	09	25	50	4,350	
1	1976	metric tons)	3,495	1,640	850	392	152	148	313	78	33	20	25	3,560	
al	1970	000.)-	2,902	1,269	815	287	159	06	282	42	29	13	1	3,102	
Actual	0961		1,883	765	620	171	66	25	203	114	17	37	1	2,035	
	1955		1,857	801	750	133	95	23 .	148	93	99	27	1	1,950	
			Developing Countries	Malaysia	Indonesia	Thailand	Sri Lanka	India	Others	Centrally Planned Economies	Vietnam	Cambodia	China, Peoples' Rep.	WORLD TOTAL La	

The differences are the statistical Za For the year 1955, 1960, 1970 and 1976, the world total is not the sum of the two sub-totals, discrepancies shown in IRSG data.

Source: International Rubber Study Group (actual), FAO, Commodities Division (projections).

The projections show that world NR output can be expected to grow at about 4 per cent per annum between 1976 and 1990, that is at slightly over 1 per cent per annum above the historical rate. The growth path of NR production, however is likely to be quite uneven: after a 5.1 percent per annum growth in the remainder of the 1970s, the annual rate of expansion is anticipated to fall to slightly less than 4 per cent in the first half of the 1980s and to about 3 percent in the second half of that decade (Table A). During the 1976-1990 period, rubber production is projected to grow at above historical trend rates in Thailand, the smaller producing countries and possibly in Indonesia. Malysia and Sri Lanka are, on the contrary, expected to increase their tubber production at rates below those experienced from the mid-1950s to the mid-1970s. In the case of Malysia, this result stems from the slow-down in new planting and replanting rubber in the rate 1960s and early 1970s when oil palm production became more attractive than rubber pro-duction, particularly to estates. The lack of a vigourous rubber replanting policy in the 1960s and 1970s, is the main cause of the expected slowdown of rubber output growth in Sri Lanka dur-

On the whole, while NR production can with a reasonable degree of confidence be expected to a reasonable degree of confidence be expected to increase during the next 15 years at a faster pace than in the past 20 years, the accuracy of the norm projections presented here depends to some extent on the future production projections of Indonesia and of the smaller producers, both of which are subject to a considerable amount of uncertainty. Indonesia might not reach the production norms shown in Table A, particularly during the 1980s. The short-term production potential of the smaller producers may also be

- (i) A price for RSSI, CIF New York, of about 40e/lb (in 1977 constant S terms) would probably fulfill these assumptions.
- (2) Malysia, Indonesia, Thailand, Sri Lanka and India. (3) Liberia, Nigeria, Zaire, Vietnam, Cambodia, Brazil, the Philippines and Ivory Coast.

Phytophthora Botryosa Chee Causing Abnormal Leaf Fall Disease on Hevea Brasiliensis in South Andaman Island in India

The abnormal leaf fall disease of rubber caused by Phytophthora spp. is a serious, annual recurring disease of rubber in India. Three species of Phytophthora, P. palmivora (Butl) Butl; P. meaddi Me Rae and P. nicotianae var parasitica (Dastur) Waterhouse are reported to cause abnormal leaf fall disease on Hevea in India. Incidence of this gen isolated was observed to be different from the three species of *Phytophthora* reported from the main land. This isolate was identified as *P*, botryosa Chee.

The pathogen was isolated and brought into pure culture. When artificial inoculation was pane curture when artificial inoculation was carried out with this isolate on cut twigs of rubber, cent per cent infection was obtained. The patho-gen produces sporangia abundantly, observed in large clumps, which help in the quick disease nation of the disease during the disease season. This pathogen is as virulent as the other three species of *Phytochthora* causing abnormal leaf fall disease of rubber in India.

India: 'Bread Basket of the World'

Dr. M. S. Swaminathan, Director General of Indian Council of Agricultural Research (ICAR), underscored the country's potentialities to become a major agricultural power.

"Just as reaching the moon is no longer a science fiction, (this country) becoming a bread basket of the world need not remain a piece of wishful thinking," he said, delivering the founda-tion day lecture of the administrative staff college at Hyderabad on 4th January 1979.

What was needed was an appropriate blend of economically viable technology and services to farmers, together with public policies to stimulate production as well as consumption. "This is the only pathway which can help us solve the twin

India's blessings

major agricultural power, Dr. Swaminathan said it possessed abundant sunlight which was the most important requirement for good crop growth. There were subatantial resources of irri-

Besides, the potential for animal husbandry and acquaculture was immense. "Above all, we have a hardworking community of farmers and fishermen. Our rural women are gifted with considerable finger skills."

Outlining some of the requisites for making the vision a reality. Dr. Swaminathan emphasised the need for introduction of improved farming systems. Agriculture could become a potent instrument of generating more jobs and income in the villages only though an integrated approach.

Multiple Cropping

Unfortunately he said, development efforts so far had been either individual crop oriented or animal oriented, and not aimed at the eatire farming system. Multiple cropping would help generate more income and employment, particularly in small holdings.

He cited in this context the efforts being made by scientists to develop techniques to enable

farmers to take either three sugarcane crops in two years, or sugar cane and rice or sugarcane and wheat in the same year. Such techniques would help extend the crushing season in facto-

If real income was to be improved, there should be a gradual withdrawal of labour from the routine operations of farming and their employment in a wide variety of occupations basic to scientific agriculture. The process of modernisasciential agriculture would open up a whole series of new job opportunities. He said modernisation of agriculture did not mean displacement of human labour with machines, but implied removal of human drudgery, improvement of human energy input-output ratio and, above all, diversifi-

Ecological Infrastructure

was the production of hybrid cotton through hand emasculation and pollination. Dr. Swami-nathan also emphasised the need for strengthening the ecological infrastructure. For promoting economic ecology a national movement was

Multiple cropping and improved post-harvest technology were two areas which could immedia-With appropriate post-harvest technologies, every

Referring to pulse crops which could find an important place in the multiple cropping system, Dr. Swaminathan said, compared to cereals, pulse research was still to make headway. ICAR was establishing schools of basic research in all important pulse crops to improve production and

Dr. Swaminathan said the package of agricultural production technology needed to be supported by appropriate packages of services supported by appropriate packages of services and public policies. The public policy package should include land reforms, integrated input-output pricing policies and effective marketing. Besides, it would be desirable to develop an agricultural credit insurance system to protect farmers from weather risks.

Evaluation of the Rubber School on the Air

"Radio in the service of the farmers" is a concept which is as old as broadcasting in India. But the idea of running a "Farm School on the Air" is of recent origin. The fifth course in the Farm School on the Air Stries of AIR, Trichur was devoted to "Rubber Cultivation."

The Rubber School on air was designed to cover all aspects of rubber cultivation. Practical aspects were highlighted giving a brief mention about the theory side. All the lessons were prepared in such a way that they should be useful to the average small grower having a certain amount of informa-

with the experts in the field. 39 lessons were broadcast in the series. Each lesson was prepared by concerned subject expert. The lessons broadcast were re-edited by the authors themselves for publication in the 'Rubber'. Now they are being serialised in the 'Rubber' a widely circulated Malayalam magazine of the Rubber Board. Rubber Board also intends to bring out a Malayalam Book on 'Krishipatom' incorporating the articles serialised in the Magazine. The Book is now under print.

The course on the rubber cultivation was formally inaugurated on the radio by the then Chairman Prof. K. M. Chandy at 7.05 a. m. on 5th November, 1977. The first lesson in the course was followed on 8th November, 1977 at the same time.

The pattern of broadcast of the course was to present a new lesson every Tuesday, repeat the lesson in full in coming Thursday and to broadcast the questions raised by listeners and their replies prepared by experts the coming Saturday. The course was completed in 39 weeks.

A mid-course evaluation of the rubber school on Air Programme of AIR was under taken in 19 villages in Meenachil Taluk, Kottayam District in Kerala between 15th and 22nd March, 1978. A random sample of 500 small rubber growers and 26 registered listeners for the course were interviewed for the study. Some of the interesting features of the study are summarised here.

The study was conducted by the Audience Research Unit, AIR, Trivandrum.

- 1. About 74% of small rubber growers possess radio receivers. On the whole, about 86%
- About 47% of those not possessing radio/ transister also listen to it mostly at the neighbours' (59%) or friend's (29%) house. Radio listening at panshop and Panchayat radio is reported by 13% and 8% of non-owners, respectively. Radio listening mostly seems to take place in a friendly and intimate place rather than at an impersonal location suce as panchayat radio or panshop.
- About 7 out of 10 listen to radio almost daily. Programmes with larger audience appeal are film music (88%). News and News items (87%), plays and features (68%) agricultural programmes (60%) and Yuva Vent (\$790.)
- About 65% of sample rubber growers are aware of the Farm School programme. The first sources of information for them are radio (72%), News papers (18%) and 'Rubber' magazine (4%).

- 5. Out of those aware of Farm School, only 38% are aware of its correct time of broad-
- About 53% of general sample or 82% of those listening to radio report listening to Farm School sometime or the other.
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The low popularity of Sanskrit news immediately preceding Farm School may be affecting with a negative inheritance factor.

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- Out of these listening, half resort to planned listening (8% of the sample) It is chance and partial listening in the case of the rest (another 8%).
- About 63% of general and 92% of registered listeners opine that repetition of lessons is necessary.
- 11. While the frequency, duration and presentation of Farm School is considered as satisfactory and the lessons are easy to follow, the present time is termed as inconvenient by 50% of general and 42% of registered listeners. The alternate time preferred is between 8.00 and 9.00 P. M.
- 12. The format of talks/lecture adopted for the Farm School needs to be changed according to 46% of the general and 54% of the registered listeners. The 'question-andanswer' format is favoured most.
- About 70% listeners report 'gain in knowledge' and 42% report instances of specific

- benefits derived by listening to Farm School programme.
- 14. The assessment of the Farm School by the listeners shows that 83% of general and 100% of registered listeners consider it as "useful."
- 15. It is revealed that had the time of broadcast been more convenient and larger incentives been offered, at least 40% of those listening to the programme would have become registered listeners.
- 16. The in-built feed-back system of eliciting questions from listeners is inadequate and greater organisational efforts are required to make it a truly participatory communication.
- 17. About 30% of the listeners disseminate information on Farm School among others. And about 30% of the sample who subscribe to 'Rubber' magazine invariably refer to Farm School lessons printed in it.

Test-tube Trees

Indian scientists have grown forest trees in test-tubes. This remarkable development, using what is called 'tissue culture' can revolutionise agriculture, forestry, and partially solve the burgeonine fuel crisis.

Dr. V. Jagannathan of the National Chemical Laboratory and a pioneer in test-tube plants, told the Science Congress that success had been achieved in growing teak and eucalyptus by tissue culture. Eucalyptus is difficult to multiply from cutting and teak takes long to grow. But by culturing a few cells from a section of the eucalyptus tree, "several thousand plantlets can be grown in a year in test tubes' he said. The plantlets are then transferred to the soil.

Experiments

Several of the test-tube plantlets have been planted by the Maharashtra Forest Development Corporation. Dr. Jagannathan said 12 plantlets of teak are also undergoing field tests. Dr. Jagannathan said it was possible to use this method to multiply virus-free and disease-resistant plants.

This was done by cutting the virus-free section of a fullgrown tree and then culturing the cells in test tube. The trees growing out of such cells would be free of virus.

This had already been proved in the case of sugarcane. He said several thousand virus-free high-yielding sugarcanes were undergoing field trials

Some cashewnut trees in India give a high yield of 60 kg per tree. These trees can be multiplied by tissue culture. Similarly, coconut trees which produce 600 nuts in a season can be multiplied. Dr. Jagannathan said once the quiek-growing fuel trees were identified, 'we can multiply them be trieste authur to meet the freewood crists'.

Tripura to Boost Plantations

A vigorous drive has been initiated by the Tripura Government to improve its tea and rubber plantation industry and set up a large paper mill in the State.

The Chief Minister, Mr Nripen Chakravarti, said in Calcutta on Sunday that an additional 600 hectares of land would be brought under the State's lately developed rubber plantation programme.

The State would produce about 35 tonnes of rubber during the current year. The country's annual natural rubber production is estimated at 1500 tonnes.



Aspirins for Plants

Aspirins may soon relieve a major headache for countries that suffer from droughts.

Research in Britain holds out promise that crops in such areas could be prevented from dying if sprayed with an aspirin solution, according to a British Information Service report.

The discovery that aspirin reduces the rate at which plant leaves lose moisture to the air was made by Prof. Alfonso Larque Scavendra from Chaping, Mexico.

Using the very sensitive techniques and equip-ment developed by the Lancaster University bo-tanists, Prof. Larque Seavendra has been examinin the leaves and limits the moisture loss.

The professor has now returned to Mexico to continue studying the effect of aspirin on the effi-ciency of water use in plants.

Prof. Mansfield of the Lancaster University Department of Biological Sciences says:

"This is an important and significant discovery. In its an important and signment discovery, Scientists have for some time been looking for an effective compound to enable plants in dry areas to conserve water. Aspirin has the advantage of being cheap, easy to apply and is effective in very low quantities. As far as we know, it has no harmful side effects."

(Seeds and Farms-Vol. V. No. 2, Feb. 1979.)

Prospects bright for NR

Natural Rubber would again dominate the world market as the demand for the commodity is constant while the price of synthetic rubber is always on the increase, observed a Rubber Plantation Executive in Semarang (Central Java). Ir. that production of synthetic rubber depended on natural oil. Shortly after World War II synthe-tic rubber took the lead on the world market, enjoying 65 to 70 percent of total transactions. However, as synthetic rubber became more popular, its price went up and up, giving way once

PT Perkebunan is at present making efforts to enhance the quality of its products by reducing the acreage of rubber plantations.

World Rubber Market

The beginning of the year 1979 was a period noted for quite a lot of changes in the international scene in respect of rubber prices. In the first week of January, the market has come back from the brink. After falling to a low of about 59,20 pense (Rs. 9/77), per kilo, the July/September 53.20 pense (Rs. 3/17) per kind, the subjectioner position in the London terminal market has recovered to a closing level of 61.27 pence (Rs. 10/12). However, the 61.00 pense (Rs. 10/07) level was proving something of a resistance point.

One of the major factors helping the recovery has been the conflict in Cambodia, which has reminded the market of the threat that a Communist take over in South east Asia poses, at least potentially to production in Thailand and

In the first week of January 1979, the market lacked the offtake necessary to maintain prices and prices are now back to mid July levels. Inspite of all this, the fundamentals remain largely weekenset free. Inspite of all this, the fundamentals remain largely unchanged from a few months ago. However, the world economy is not expanding particularly quickly at present, so there is a possibility that the rubber market will pause and consolidate later this year. However, the hope in the market is that the world economy will be starting more towards the end of the year. And by then the higher price of oil will have worked its way through to the price of synthetic rubber giving the natural product more scope for a rise.

(Financial Times-World Commodity Report)



ETHEPHON CONFERENCE

Planned use of Ethephon has assumed great importance now, as the production of natural rubber in the country has recorded a decline and the demand for natural rubber is on the increase. Ethephon was not available in the country during the last year and still there is uncertainty with regard to the supply position of Ethephon. For a planned use of Ethephon, for stimulation of yield, an assessment of the total area suitable for stimulation, and the availability position of the chemical is imperative. With these objectives in view a conference was held at the Rubber Research Institute of India (RRII) on 4th January 1-79 where planters, importers, scientists from RRII and other Rubber Board Officials participated.

The Director of Research, Shri, V. K. Bhaskaran Nair, welcomed the participants and explained the objectives of the conference. He ascribed the non-availability of Ethrel during the last season the delay in getting clearance from the Central Insecticides Board. Rubber Board took up the matter with them and finally obtained the clearance in September 1978. Dr. M. R. Sethuraj, Plant Physiologist initiated the discussion. According to his estimates, 5000 ha tapped on D or older panels are available for Ethephon stimulation. This area should be stimulated thrice an year with 5 per cent Ethephon. With a view to increasing production, now RRII recommends one single annual application of Ethephon in C panel also. 50,000 ha are now estimated to be under C panel. A target should be fixed to bring 40 per cent of the area (20,000 ha) under such stimulation. The total requirement of Ethephon for 5,000 ha of

of C panel (single application; 5 per cent) would be 26,250 pints of 10 per cent Ethephon. Dr. Sethuraj also stressed the need to liberalise the import of Ethephon and to issue import licence to actual users (planters). It was pointed out that in order to produce an additional yield of 1000 tons, the Ethephon required would involve only a foreign exchange of 3.5 lakhs whereas to import 1000 tons of rubber the foreign exchange involved would be about 88 lakhs. Planters representing all the major plantations (Cochin Malabar Estates, A. V. Thomas & Co., Malayalam Plantations, Aspinwall & Co. Ltd., T. & T. Estate) participated in the discussion Mr. Sivasankaran Nairo (Cochin Malabar Estates and Mr. Henon of Malayalam Plantations requested to expedite action on their applications for import of Ethrel. The Rubber Production Commissioner Shri. P. Mukundan Menon explained the position regarding the import application of M/s. Cochin Malabar Estates. Considerable delay is experienced for the clearance by DGTD. A policy decision was taken that Rubber Board will recommend import applications for Ethephon from all major users. Shri. Menon suggested that the present importers may concentrate on supplying the chemical to the easelts epichations and holdings.

Mr. John Verghese of Shaw Wallace informed the gathering that the latest consignment of 3500 pints has been sold out and they expect another consignment of 4000 pints in January and 5000 pints in March. Mr. Gopalakrishoan of Mys. Bharat Pulverising Mills stated that they expect a consignment of 10,000 pints during February. As per the estimates, Cochin Malabar Estates and Malayalam Plantations together would require about 10,000 pints. Mr. Upendran of A. V.



Participants

Thomas & Co. has informed the gathering that they have carried out stimulation (2.5 per cent) even in virgin bark and obtained satisfactory results. Dr. Sethuraj observed that one or two applications of 2.5 per cent Ethephon in virgin bark may not do any harm although a declining trend in response may still be obtained. Mr. Rajapadmanabhan of T. R. & T. informed the gathering that NCL know-how for indigenous production of Ethephon is available for sale and that the plant has a capacity to produce 6 tons of Ethephon per annum.

The Rubber Production Commissioner stated that some firm in Bangalore is trying for indigenous production of Ethephon with NCL knowhow. Dr. Sethuraj pointed out that NCL has not replied for many enquiries on this matter and hence he was not in a position to say when indigenous production commissioner suggested that someone from Research Department should visit NCL to find out the position.

In conclusion the Director of Research stated that if the importer can actually supply the quantity of Ethephon they have promised to, there might not be any problem of shortage of Ethephon next year. NCL will be contacted to find out the actual position regarding the indigenous production of Ethephon. Rubber Board will recommend Import application for Ethephon from major actual users (plantations).

'SIET' Institute and Training Programme

The Small Industry Extension Training Institute at Yosusfiguda, Hydrabad in Andhra Pradesh is organising a two week technomanagerial programme on "Production Management for Rubber Processing Industries" from 16th to 28th April 1979 at its own premises. The course includes lecture session, film show, factory visits etc. focusing the topics on process, inventory management, motivation, work study, quality control etc. This programme is expected to come with new industrial prospects for the growth of rubber industries. The bonafide small industrialists are eligible for fee concession. Those who require details on fee structure, nomination forms etc. should address to the Registrar, SIET Institute, Yosusfiguda, Hydrabad-500 045.

Rubberisation of Roads

The roads within the campus of the Rubber Research Institute of India are being rubberised now. When finished this strip of 2 kilometer long and 3 meter wide road will be the longest single rubberised stretch in the country. The rubber-bitumin mix for rubberisation is formulated by blending one drum of boiled bitumin weighing 156 kilogram with 9 litres of natural rubber latex and 8 litres of kerosene. For rubberising a strip of 2 kilometer road 80 drums o



The road being rubberised at the Rubber Research Institute of India

bitumin, 720 litres of rubber latex and 640 litres of kerosene are needed,

Rubberisation costs only 20 percent extra over the usual bituminisation while rubberised roads have 50 percent more life than bituminised roads. Besides they provide better grip for motor vehicles thereby adding to the riding comfort and road safety.

In 1973 the Rubber Board in association with the Kerala PWD had rubberised I kilometer of the Main Central road at Vembayam near Trivandrum which even now remains in tact despite the heavy traffic to which it is being subjected to.

V. K. Bhaskaran Nair Director of Research

The Union Ministry of Commerce has issued orders appointing Shri V. K. Bhaskaran Nair as Director of the Rubber Research Institute of India. Shri Nair has been officiating in this position since March 1978.

Shri Bhaskaran Nair joined the Rubber Board in 1958. Earlier he was serving the Rubber Research Institute of Malaysia as Botanist. As head of the Botany Division of the Rubber Research Institute of India Shri Nair had twice officiated as Director of Research. As one who made signal contribution for modernising the Rubber



Plantation Industry in India. Shri Nair has been intimately associated with the evolution of the high yielding rubber clone RRII-105.

Doctorate to V. Haridasan



The University of Cochin has awarded the Degree of Doctor of Philosophy to Shri V. Haridasan, Economist of the Rubber Board for his descriation "An enquiry in to the management practices followed in rubber estates in India." Shri Haridasan had pursued his research studies at the School of Management, Cochin under the guidance of Dr. M. V. Pylee, Vice-Chancellor of the University of Cochin when he was the Director of that School. The thesis attempts at an elaborate analysis of the management practices prevalent in Indian and non-Indian Rubber Estates.

Supply and demand position of rubber

Shri. S. G. Sundaram IAS, Chairman Rubber Board revealed that the natural rubber production for the year 1978-79 at 140,009 tonnes estimated by the Board had to be revised to 135,000 tonnes based on the trend up to December 1978 and possible production till March 1979. He was presiding over a meeting of the Statistics and Import Export Committee of the Rubber Board held on 31st January 1979. Loss of tapping days due to heavy monsoon and strike of plantation workers had limited Natural rubber production to 86,600 tonnes during April to November 1978 as against 99,500 tonnes during the same period in 1977. This year's poor winter may also be a limiting factor on Natural rubber production. The quantity of rubber already imported and the consignment proposed to be imported would

come to a total of 30,000 tonnes. During the period from April to December 1978, the production of synthetic rubber in Bareilly factory was only 18,079 tonnes as against 20,197 tonnes during the same period last year. The production until March '79 might not exceed 24,000 tonnes. The Polybutadine rubber produced by the Indian Peirochemical Corporation was 3158 tonnes and by March '79 their production would go up to 5000 tonnes only. Import of special purpose synthetic rubber would be only around 8000 tonnes.

Consumption

The Chairman said that the consumption of ruber had gone up beyond expectations, registering .3% growth rate in tyre sector and 81% in non-tyre sector during April to November 1978. The demand for auto-tyres and tubes in increasing the consumption would keep its increased pace. The demand for natural rubber during 1978/79 would go upto 165,000 tonnes.

Prospects

The prospects for both production and consumption would be bright during 1979/80. The Chairman said that the existing price offered the growers especially in the small sector, sufficient incentive to do plant protection and fertilizer application. The average price realization for lot rubber from May '78 to January '79 was Rs. 981-per quintal as compared with Rs. 632/- during the corresponding period of the previous year. For growers the yield stimulant 'Ethref' would be imported in sufficient quantity. The provisional estimate of production in the forthcoming year would be 155,000 tonnes. Consumption also would be provisionally placed at 175,000 tonnes assuming a growth rate of 8%.

Supply and demand

The committee examined in detail the supply and demand position of rubber. The position for 1979-80 estimated provisionally is given below:

below:	NR	SR	Total
Opening stock Production	43,000 155,000	10,000 37,000	53,000
Import of special purpose synthetic rubber		8,000	8,000
Total Less consumption	198,000	55,000 45,000	253,000
Dalance Stock	23.000	10,000	33,000

Dr. Rama Varma-

We record with profound grief the sad demise of Dr. Rama Varma, one of the illustrious former Chairmen of the Rubber Board, at Lissy Hospital, Cochin on 20th March 1979 following an attack of Cardiac Asthma. He was 67.

Dr. Varma, a noted economist, farsighted administrator of remarkable efficiency, perfect humanist, arch socialist, incarnation of integrity and intellectual honesty had presided over the Rubber Board from 1961 to 64 with distinction industry have attained their present stature, glory and eminence largely due to the strong foundation of growth laid down during the tenure of Dr. Varma at the helm. The attempts made by him to organise the vulnerable section of the rubber plantation industry through co-operatives and paid rich dividents as testified by the comercial of a large net-work for rubber co-operatives which holders of rubber.

The rubber plantation industry in India earned its national and international acclaim during Dr. Varma's time. In his death the country at large and the rubber industry in particular has lost a









MM Muthiah

Shri MM Muthiah (48) a former member the Rubber Board, died in London on 6th 3a ary, 1979. A prominent industrialist by tradia and practice. Shri Muthiah was a leading pia too. He had been the President of UPASI 1975. As member of the Rubber Board for full terms, Shri Muthiah had made signal corpution for the promotion of the rubber indus.

"In life we shall find many men that are great, and some men that are good, but very few men that are both great and good."

Book review

'Rubberinte Katha'

Author: M. Basheer Kutty Price: Rs. 5 Language: Malayalam.

Rubber is not unknown to any one who lives in the present day world since it plays many a role in different facets of life. Now it is inconcievable for the modern man a life devoid of rubber. The book entitled 'Rubberinte Katha' in Malayalam by Shri. M. Basheer Kutty narrates the story of rubber from the time when it was nothing more than an academic curiosity brought home by explorers from the Amazon Jungle up to the present day, when rubber has become one of the most useful materials that the world has ever witnessed.

The scarcity of natural rubber led to the invention of synthetic rubber. Today synthetics account for [23] of the total consumption of rubber in the world. The book throws light to the evolution of synthetic rubber also. The contributions of Thomas Hancock, Charles Macintosh, John Boyd Dunlop, Charles Goodyear and other pioneers to the development of rubber industry have been dealt with in detail. A separate chapter has rightly been devoted for Charles Goodyear whose inventive cenius had con-Charles Goodyear whose inventive genius had converted rubber into the most important industrial

The manufacture of rubber goods is also dealt with in such a lucid style that persons with no scientific background can well follow the subject. A detailed bibliography on the various aspects of rubber is given as appendix .- KAA

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