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Natural Rubber : Agromanagement and Crop Processing
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Chapter 1

Indian rubber plantation industry : Genesis and development

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1. INTRODUCTION

Hevea brasiliensis, a forest tree which is indigenous to the tropical rain forests of Central and South America and the only major commercial source of natural rubber (NR), is one of the most recently domesticated crop species in the world. The modern age of NR actually started during the 1870s when the British successfully transported *Hevea* seeds from Brazil for planting in the then British India (Markham, 1876; Petch, 1914). Even though the domestication history of *Hevea* was chronicled, analysed and reviewed by many (Wycherley, 1968; Drabble, 1973; Schultes, 1977; Dean, 1987; Baulkwill, 1989; Jones and Allen, 1992), the role of India in the process is not duly brought out.

2. FROM THE WILD TO PLANTATION RUBBER

2.1 Wild rubber

The unrecorded stories of rubber and its usage preceded the recorded history by many generations, probably centuries. In Spanish, rubber is called 'Caucho', in French it is called 'Caoutchouc' and in German 'Kautschuk'. All these names are derived from a native Peruvian expression for the 'weeping wood'.

Long before the discovery of the American continent by the European colonial powers, rubber was known to the native civilizations of Tropical America. In the Inca civilization of Peru, the Maya civilization of Yocatan and the ancient Mexican civilization, rubber was used as a magic substance and had a significant role in rituals, sorcery and witchcraft. Protective garments and solid playing balls made of rubber and banners spread with rubber have also been recorded by the earliest visitors to that continent (Schurer, 1957).

2.1.1 Pioneer investigations

When rubber started to become popular in Europe in the 16th century, Spain was the principal colonial power in the Tropical America. Christopher Colombus, reportedly, had taken a few rubber balls on his return from West Indies to illustrate one of the 'wonders' of the 'New World' (Schurer, 1956). The arrival of these rubber balls in Spain in 1496 is the first known presence of natural rubber in Europe (Crouch, 1937; Baker, 1996). The earliest reference about rubber appeared in print in 1530 in the Spanish book, 'De orbe novo' by Peter Martyr (Schurer, 1958). The Spaniards had discovered the primitive use of rubber for water proofing. Francisco Hernandez, a Spanish physician also described a rubber tree based on first hand information (Schurer, 1958).

Two French men, C. Francois Fresneau (1703-70) and Charles de La Condamine (1701-74), deserve the honour for familiarizing rubber to the scientific community in Europe. Fresneau was the first 'to have conducted a planned search for the tree..... and to have identified and given a general description of *Hevea brasiliensis* and the methods of tapping and for the preparation of crude rubber' (Jones and Allen, 1992). In 1755, Condamine published a paper which was entirely devoted to rubber, based on the information provided by Fresneau (1951). French chemists, especially L.A.P. Herissant (1745-69) and P. J. Macquer (1718-84) investigated on the solvents for rubber (Johns, 1952). F. Aublet, a French Botanist, published the botanical description of *Hevea* in 1775. The taxonomy of the genus had undergone a number of changes which have been later narrated by R.E. Schultes (1970).

The British have probably identified and made use of its unique practical use for erasing pencil marks at the beginning of 1770s. During that time Edward Nairne, a maker of scientific instruments, started selling small cubes of rubber as erasers in London (Schurer, 1953). Joseph Priestly (1733-1804), who is widely credited with the invention of hydrogen, in his book on perspectives, drew attention of draughtsmen to the advantages of the 'substance excellently adapted to the purpose of wiping from paper the marks of a black-lead-pencil' (Priestly, 1770). Priestly, however, did not use the term 'rubber'. The popular assumption that Priestly wrote his lines and henceforth the term 'rubber' was born and

used afterwards is too much a simplification of a very long chain of events (Schurer, 1954; 1965a,b,c). The eraser application had apparently remained as the only British contribution to the practical uses of rubber for about half a century.

2.1.2 Genesis of the industry

The pioneers of the British rubber industry were Charles Macintosh (1766-1843) and Thomas Hancock (1786-1865). In 1818, James Syme, an Edinburgh medical student, discovered that naphtha can be used as an efficient solvent for rubber (Schurer, 1952). Macintosh, a chemical manufacturer in Glasgow, skilfully used this solution as a water proofing layer between two fabrics to develop the famous 'Macintosh' water proofing process in 1823 (White, 1974) and a factory was opened at Manchester in 1824 for its production. Close to water proofing of fabrics, came the discovery of mastication by Hancock (Fig. 1) to produce rubber in cylindrical form and subsequently as blocks of rubber in any desired size and shape. In 1820, Hancock invented the hand-driven wooden masticator which was replaced by a horse-driven machine in the very next year and was soon transformed into steam-driven metal machines (Duerden, 1986). Addition of fillers to rubber, compression moulding under heat, cutting, solution dipping and latex thread technology, *etc.* were some of the patents added to Hancock's list by 1825.

Rubber manufacture in America was started during 1830 for the production of shoes. In 1836, E.M. Chaffee of Roxbury Rubber Company patented calender as a device to produce rubber sheet of uniform thickness without using solvents. Later in 1845 H. Bewley devised the extruder for producing articles in continuous length of uniform cross-section as with tubing, hoses, cable covering, *etc.* The machine originally designed for gutta-percha was subsequently modified by Shaw, Royle and others for the rubber industry (Pickles, 1958).

By mid-1830s there was a flourishing rubber manufacturing industry in Britain and North America, but all the products ranging from domestic and sport articles to surgical, mechanical and engineering goods were unvulcanized. Britain, with its predominantly wet climate, proved ideal to market the macintosh, based on unvulcanized rubber but the extreme temperature changes in America made the rubber products either sticky due to excessive heat during summer or brittle due to severe cold during winter leading to loss of confidence in the new industry and subsequent closing of many factories. The search for a solution to this problem led Charles Goodyear (1800-60), an American hardware merchant turned rubber manufacturer, to the historic discovery of vulcanization (Pickles, 1958), a process of heating rubber with sulphur at a high temperature to improve its strength properties. Rubber after vulcanization becomes less susceptible to the actions of solvents and to temperature changes and Goodyear patented his invention in America on 6 December 1842. Hancock was successful in obtaining a separate British patent in November 1843, a few weeks before Goodyear's belated British patent (Duerden, 1986). Alexander Parkes, who patented the use of carbon disulphide as a solvent for rubber, used the solution for making water-proofed fabrics in 1847. His invention of cold curing of rubber by immersing in a solution of sulphur chloride in carbon bisulphide in 1846 is also worth mentioning (Pickles, 1958).

Fig. 1. Thomas Hancock (1786 – 1865)

Fig. 2. Clements R. Markham (1830 – 1916)

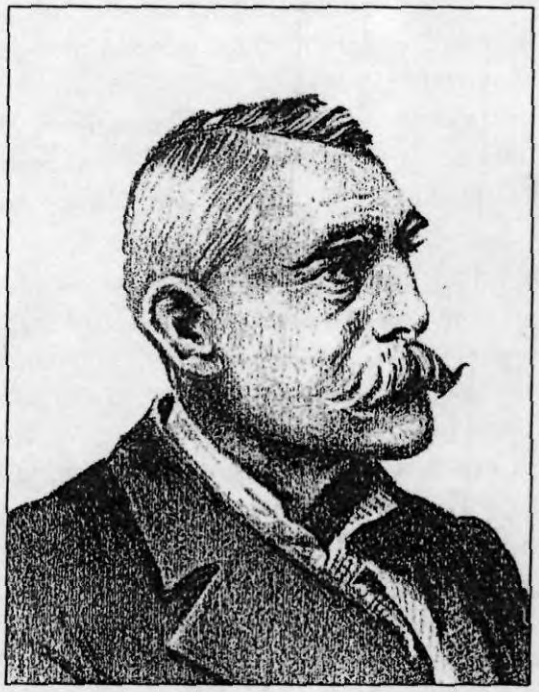

Fig. 3. Henry A. Wickham (1846 – 1928)

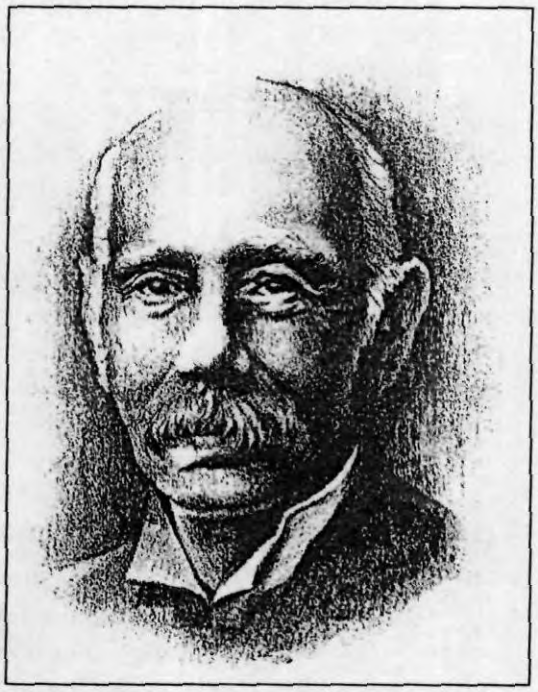

Fig. 4. Henry N. Ridley (1855 – 1956)

The fundamental changes in the properties of NR through vulcanization removed most of its susceptibilities to climatic conditions and its limitations as a raw material for mechanical applications. Vulcanized rubber was used by Fuller in 1845 for making the ends of railway carriages as cushions to diminish the effects of concussion. Charles de Bergue employed vulcanized rubber rings between metal plates in buffering and traction apparatus. In 1853, George Spensor patented the first rubber railway spring which led to a series of inventions (Pickles, 1958).

The most spectacular development in the annals of rubber was the invention of pneumatic tyres. The first pneumatic tyre patented in 1845 by Robert William Thomson (1822-1873), a Scottish engineer, did not achieve commercial success. After 50 years, in 1888, John Boyd Dunlop (1840-1921), a veterinary surgeon from Belfast, reinvented and patented pneumatic tyre and its advantages were quickly appreciated (Tompkins, 1981). The Michelin Brothers, Andre (1853-1931) and Edouard (1859-1940), competed in Paris-Bordeaux car race in 1895 on a vehicle fitted with pneumatic tyres. The Dunlop company produced the first motor car tyre in 1910. Aircraft tyres were first marketed around 1910 and the first truck tyre in 1917.

2.1.3 Growth in demand

Since 1815, the rubber manufacturing industry began to expand and the imports of rubber into Britain and America increased considerably (Table 1). Since the invention of pneumatic tyres, the prosperity of world rubber industry was to a large extent, dependent on the development in world automobile industry (Bauer, 1978).

Table 1. Consumption of rubber in Britain and America during the 19th century

Year	Rubber consumption (t)	
	Britain	America
1830	23	*
1840	307	*
1850	385	*
1860	2152	750
1870	7656	4296
1880	8479	8109
1890	13200	15336
1895	17078	18646
1900	25664	22026

Source : McFadyean, 1944 * Not available

2.2 Plantation rubber industry

During 1850s, most of the rubber for the world rubber industry came from *Hevea*, *Ficus elastica* and *Castilla elastica* which grew wild, in the forests of Central and South America, India, Africa, Madagascar, *etc.* South and Central America was the main contributor of wild rubber, the share being 71 per cent (Markham, 1876). The flourishing rubber industry in Britain found it difficult to sustain itself with the limited supply of wild rubber from Tropical America. With the growing demand due to rapid growth, the rubber manufacturing industry in Europe and America had to widen the source of supply of their raw material

which stimulated the search for rubber world over. Hancock suggested the initiation of rubber cultivation in the East not only as a profitable plantation venture, but also as an insurance against interruption of supply (Hancock, 1857). Thus, the colonial powers initiated a scheme for introducing rubber as a wonderful plantation agricultural crop in the South East Asia to feed the industries located in the metropolitan centres of Europe.

2.2.1 India and the domestication of rubber

Long before the introduction of the Para rubber tree to India and other South East Asian countries, indigenous rubber yielding trees (Assam rubber) were tapped on a commercial scale in Assam. William Roxburgh, keeper of the Calcutta Botanic Gardens in 1798, identified the trees as *Ficus elastica* . The recorded average annual production from Assam rubber during 1882 to 1887 was 207 t (Watt, 1890; Schurer, 1956).

The real initiative for the historic domestication of Para rubber in the East came from Sir Clements Robert Markham (1830-1916) of the India Office in London (Williams, 1968), who is credited with the adventurous and successful transfer of cinchona plants from Peru to India during the early 1860s (Williams, 1962). Markham (Fig. 2) was confident that rubber could also be successfully introduced to the East as done for cinchona (Markham, 1876).

James Collins, Curator of the museum of the Pharmaceutical Society, London; Henry A. Wickham (Fig. 3), a planter, rubber trader and naturalist; Joseph D. Hooker, Director of the Royal Botanic Garden, Kew, London and Henry Nicholas Ridley (Fig. 4), Director of the Singapore Botanic Gardens also played decisive roles in the domestication of rubber in the East (Eaton, 1935). Royal Botanic Garden, Kew made significant contributions in propagation and distribution of the planting materials procured from Brazil.

2.2.2 Initial unsuccessful attempts

The domestication of rubber in the East was entirely a project initiated and financed by the then Government of India through the East India Company, in which Markham was the prime mover. James Collins had published two papers on *Hevea* during 1865-70 and Markham was behind the move of appointing him for drafting a feasibility report (Collins, 1872). Collins' report favoured *Hevea* along with *Castilla* and *Ficus elastica* and recommended acquisition of their seeds from Tropical America. In an endorsement appended, Sir Dietrich Brandis, Inspector General of Forests, Government of India recommended that Canara, Malabar, Travancore and the Burma coast from Moulmein southwards offered the desired condition for successful cultivation of rubber. Markham made arrangements through Hooker that Kew Garden would receive seeds and transport the seedlings to India.

The 2000 seeds collected by Charles Farris, a resident of Cametta (200 km south of Belem), arrived at Kew during June 1873 and were immediately sown. Unfortunately only 12 of them germinated (Watt, 1890; Dean, 1987). This was the first in the chain of shipments of seeds from the Amazon region. On 22 September 1873, six of these seedlings were sent to Calcutta Botanic Gardens, where experimental planting of rubber was initiated. The attempts to propagate these plants through cuttings failed as the climate was unfavourable. Only three plants were left a year later, but even these do not appear to have survived (Prain, 1914; Dean, 1987).

Markham obtained authorization from the India Office to purchase rubber seeds from Richardo Chavez, a Bolivian 'Patrao' (a merchant intermediary who provided advances to tappers of the wild trees in the Amazon, sold them supplies and bought their rubber). On 6 July 1875, seeds weighing 220 kg, packed in four barrels, arrived in London and three were consigned to Calcutta and one to Madras (Dean, 1987). Dr. King, Superintendent, Calcutta Botanic Gardens reported that some of these seeds germinated but the cold weather of Bengal proved fatal to rubber when planted in most sheltered situations. Some of the seedlings were supplied to tea planters and some were sent to the Conservator of Forests, Assam. The result obtained by them was 'not much different' (Watt, 1890). The fate of the seeds despatched to Madras was almost the same. By the time the seeds arrived there, they were no longer viable (Dean, 1987).

During 1873-96, rubber plants of various species were despatched from Kew to India, the bulk being to Calcutta Botanic Gardens (Table 2). In addition, it is reported that rubber seeds were also distributed (RBGK, 1907) and it is not unlikely that *Manihot glaziovii* and *Castilla elastica* were thus introduced to India.

Table 2. Rubber yielding plants received in India from Royal Botanic Gardens, Kew

Species	Port	Number (Year)
Hevea brasiliensis	Calcutta	6 (1873), 50 (1877)
Hevea spruceana	Calcutta	6 (1887), 6 (1892)
Castilla elastica	Calcutta	5 (1875)
Manihot glaziovii	Calcutta Madras	50 (1877), 122 (1878) 120 (1878)
Landolphia	Calcutta	2 (1882), 4 (1884)
Funtumia elastica	Calcutta	6 (1895), 6 (1896)

Source : RBGK, 1907

2.2.3 Change in location

As the attempt to grow rubber in Calcutta failed, the need for a change in the location of planting was also felt. Dr. King, Director, Royal Botanic Garden, Calcutta, suggested that subsequent seed supplies shall be sent to Ceylon (Watt, 1890; RBGK, 1898; Petch, 1914). But when Ceylon was selected as the most suitable place for the acclimatization of rubber, Dietrich Brandis' important recommendation that 'Canara, Malabar, Travancore.... offered the desired condition for the successful cultivation' (Collins, 1872) was overlooked. Thus rubber cultivation moved outside the Indian mainland and got established in Ceylon.

2.2.4 Evolution of the rubber plantation industry

Markham commissioned two more collections of *Hevea* seeds, first by Henry Wickham and the second by Robert Cross. The story of the Wickham collection is too well known (Lane, 1953, 1954; Wycherley, 1968; Dean, 1987). On 15 June 1876, seventy thousand seeds collected by Wickham arrived at Kew of which only 2700 seemed to have germinated. On 9 August 1876, a shipment of 1919 seedlings packed in portable greenhouses

was sent to Ceylon of which 90 per cent survived; of the 18 sent to the Botanic Gardens at Bogor, Indonesia only two survived; and probably one of the 50 seedlings sent to Singapore survived (Dean, 1987). The seedlings sent to Ceylon were planted in October, 1876 at Peradeniya and subsequently transferred to the more suitable site at Heneratgoda in the lowland (RBGK, 1898).

Markham, worried at the loss of seed viability during the trans-Atlantic crossing, recommended in February 1876 that Robert Cross, a gardener at Kew who had successfully introduced 134 *Castilla* seedlings from Panama in 1875, be sent to Belem, for collecting *Hevea* and *Manihot* seeds (RBGK, 1907; Wycherley, 1968). On 23 November 1876, one thousand and eighty *Hevea* and 43 *Manihot* seeds collected by Cross from Lower Amazon region arrived at Kew in poor condition of which 400 *Hevea* seeds were retained at the Botanic Gardens and the remaining 680 given to William Bull, a commercial nursery man, the number survived being 12 and 14 respectively (Dean, 1987). During 1876, seedlings from Kew Gardens were received in Ceylon, Java, Singapore and subsequently Malaya and another 22 plants were sent to Singapore in 1877 (Wycherley, 1959).

During the early days of rubber, Ceylon became the centre of activity with the Heneratgoda Botanic Gardens in Colombo being the major supplier of rubber seeds and seedlings for domestic distribution and for export. Experimental planting expanded not only in the then British colonies of Malaya, Ceylon and India but also in the then Netherland East Indies (Indonesia) which had received an early supply of rubber seeds from Ceylon.

As a new industrial crop with its commercial potentialities yet to be fully established, there was very little enthusiasm among growers initially in experimenting with *Hevea* in place of well-established and profitable crops like tea and coffee. But with the outbreak of coffee rust in Malaya and Ceylon and the consequent slump in coffee prices during 1890s, coffee growers started looking for alternative remunerative crops. Moreover, the high rubber prices stimulated by the new developments in motoring besides growing consumption of rubber in products other than tyre, especially cables (Coates, 1987; Barlow, 1978) triggered the early expansion of rubber plantations.

H.N. Ridley made historic contributions by developing the basic methods for tapping the rubber tree. This was a great improvement on the Brazilian method involving slashing, which affected adversely the life and productivity of the tree. In Ceylon, techniques of tapping and coagulation of latex were developed during 1890 (Parkin, 1899). Ridley's group, working in Singapore evolved standards for planting density, cover crop establishment, manuring, disease control and processing of latex (Eaton, 1935; Wycherley, 1959). Detailed descriptions of the symptoms of rubber diseases and their control measures were given by Petch (1914) based on his observations in Ceylon.

The growth of plantation in South East Asia was favoured by rapid developments in the transportation sector such as railways and steam ships and the opening up of the Suez Canal. By the end of the 19th century, NR became one of the major plantation crops introduced in the 'Colonies of exploitation' under colonial patronage with export-oriented estate system of production and with immigrant or indentured labour.

3. INDIAN RUBBER PLANTATION INDUSTRY

The growth of the Indian rubber plantation industry has been mainly through the expansion of rubber cultivation in Kerala. Plantation agriculture, in general, emerged in the native state of Travancore and Cochin and the Malabar area of Madras Presidency (which later constituted the State of Kerala) only during 1860s compared to earlier beginnings in other plantation districts of South India (1820s), Assam and Bengal (1840s) and Ceylon (1830s). The plantation history of the region started with coffee and cardamom plantations and then moved into tea and finally rubber. The geographical and agroclimatic suitability proved congenial for rubber cultivation in Kerala.

3.1 Genesis and early development

During the two and a half decades from the arrival of rubber seeds (1878) to the establishment of commercial plantings (1902), the rubber cultivation had to face many hurdles in India, as in all the other rubber producing countries.

3.1.1 Initial experimental plantings

The cultivation of rubber in India actually started in 1878 from the rooted cuttings imported from Royal Botanic Gardens, Heneratgoda, Ceylon (RBGK, 1898; Petch, 1914; Dean, 1987). During 1878-87, many consignments of seeds and rooted cuttings have been sent to Nilambur in Malabar (Table 3). Petch (1914) deduced that the early introduction of planting materials to India from Ceylon belonged to the first shipment of the 1919 Wickham seedlings. The trees developed from them ensured regular supply of seeds. The introduction of *Hevea* trees into India has thus been successfully accomplished.

The first attempt was to introduce rubber as a forest crop in the teak plantations of Nilambur valley under the Forest Department of the Government of Madras. In June 1879, 28 *Hevea* plants from the 33 received from Ceylon were planted at Nilambur near the Government teak plantations. On behalf of the Government of Madras, F. J. Ferguson of Calicut undertook experimental planting of Para, Ceara and *Castilla* rubber at Plantation House, Calicut and at Poonoor at the foot of the Vythiri ghat near Thamarasseri in Calicut.

In 1880, two *Hevea* plants were sent to the First Prince of Travancore and one of the plants still exist in the compound of the Archeological Museum of Kerala, Trivandrum (Plate 1. a,b). In 1881, 28 *Hevea* plants were sent to the Andaman Islands. About 3000 seeds were sent in 1888 to the Commissioner of Central Provinces, Nagpur (RBGK,

Table 3. Planting materials received at Nilambur (India) from Ceylon

Year	Type of planting materials	Number
1878	Plants, rooted cuttings	*
1879	Plants, rooted cuttings	33
1883	Plants, stumps	27
1884	Stumps	25
1884	Seeds	*
1885	Seeds	300
1887	Seeds	*

Source : RBGK, 1898 * Number not available

1898). *Hevea* and *Castilla* rubber were planted in 1881 in the Government Boatanic Gardens at Burliar in the Nilgiri Hills.

The forest officials regarded the rubber planting at Nilambur valley as 'an encumbrance interfering with the teak trees' and the rubber trees were left unattended. Ferguson's experimental planting 'was also ordered to be discontinued' (Anon, 1911). But, R. Ribbentop, the Inspector General of Forests in India (in 1898), however, strongly objected the idea of cutting off the rubber trees and advised the Forest Department to continue the experiment till the most suitable rubber yielding trees are identified (RBGK, 1898). In 1903, R.L. Proudlock, Curator of the Government Gardens and Parks, Nilgiri Hills, was deputed to report on rubber trees at Nilambur and Calicut. He reported that the assessment of the forest officials about rubber planting was based on incomplete experiments indifferently carried out as they had no time to devote to rubber trees in particular, owing to their multi-farious duties. He had also reported that the discouraging reports of the Forest Department deterred the aspirations of planters of Malabar and thus enabled the planters of Ceylon and Malaya to get ahead of them. Proudlock (1908) found that the Para rubber trees on experimental tapping yielded latex freely and of excellent quality and recommended its cultivation on an extensive scale on the coastal belts of the country lying between the sea and the foot of the Western Ghats.

A.G. Nicholson planted some *Hevea* and *Castilla* rubber trees in Howthorne estate, Shevaroy Hills, Salem during 1898 and in Glenburn estate, Kotagiri in 1902 (Speer, 1953). Para rubber was planted in Ponda, Goa during 1900 and at Aldoma and Margoa in 1906.

3.1.2 Beginning of commercial plantings

The British planters initiated rubber cultivation on a plantation scale and the state administration encouraged them by providing land, labour, capital and trade facilities. In 1862, a policy for the issue of land suitable for the cultivation of plantation crop was formulated (Anon, 1871). The liberal rules formulated in Travancore during 1860s and subsequently in Cochin for the distribution of forest and waste land for plantation crops were instrumental for the initial growth and expansion (Anon, 1871; Baak, 1992; 1997). The government forest lands were leased at very nominal tax rates. Labour control was facilitated through legislations like Criminal Breach of Contract Act, 1865. The Companies Act introduced during 1888 helped in the establishment of large enterprises which worked on the basis of share capital.

The price boom during the early 1900s attracted foreign investors to India in estate enterprises mainly through establishing Sterling Public Limited and Rupee Companies and non-Indian Proprietary Units. Planting in the first rubber estate in Travancore was initiated in 1902 at Thattekad (Plate 1. c) on the bank of Periyar river by a syndicate of which J.A. Hunter and K.E. Nichol were the active members (Anon, 1911). In 1904, planting began in Yendayar, Eldorado and Mundakayam estates aggregating to a total of 240 acres (97.17 ha) in Mundakayam region (Speer, 1953). Subsequently, the Central Travancore Rubber Company and Mundakayam Valley Rubber Company were formed in 1906. Even though G. Anderson started planting a few *Hevea* plants at Shaliacary

estate, Punalur in 1887, planting of rubber on a commercial scale in South Travancore attained momentum only in 1904 with the establishment of Sittar and Florance estates (Anon, 1911). By 1910, Travancore had become the lead state of rubber planting in India with 18252 acres (7390 ha) and Mundakayam became the main centre (Sarma, 1947) of rubber planting (Plate 1. d) with about 10000 acres (4048 ha).

In Cochin, most of the rubber plantations during the initial period came up on government land. In 1905, K.E. Nichol planted rubber at Palapilly behind government teak plantations. Similar grant of forest land was given subsequently for E.G. Windale (Pudukadu), R.L. Gudgeon (Mooply Rubber Syndicate), Lake and Schofield (Mysore Syndicate) and E.G. Windale and R.E. Campbell Gompertz. By 1910 the total area under rubber was over 6800 acres (2753 ha). In South and Central Malabar, there were five big companies, *viz.* Kerala Rubber Company, Nilambur Rubber Estates, Pullangode Estate, Poonoor Estate and Kinalur Estate, with an aggregate area over 6000 acres (2429 ha) under rubber cultivation (Anon, 1911).

During the initial phase, the Indian rubber plantation industry was controlled by British companies and the rubber produced was exported mainly to London. The colonial patronage provided better access for the British planters to surplus capital and necessary information and they held an upper hand in initial development, processing and output handling.

3.1.3 Emergence of a native planting community

The steady growth in commercialization of agriculture and the transition to capitalist mode of production in the state of Travancore and Cochin since the mid-19th century resulted in the emergence of a commercial class from the society (Varghese, 1970; Raj and Tharakan, 1983), who channelled their accumulated surplus from agriculture, trading and banking to new areas of enterprise like plantation agriculture. Rubber became their choice crop during the early 20th century (Baak, 1997). In Travancore area, the Malankara Rubber and Produce Company, floated in 1910 as a joint stock company was the first of its kind, owned by the natives and in Cochin, Vaniampara Rubber Company was started during 1911. Gradually, the Indians managed to consolidate their position (Table 4) and by 1947 about 73 per cent of the area under rubber was controlled by Indian companies and proprietory concerns (Sarma, 1947).

Table 4. Nature of ownership and area under rubber as on 31.12.1946

Nature of ownership	Area (acre)	Relative share (%)
Sterling Public Limited Companies	27305	17.25
Rupee Companies managed by Europeans	15121	9.55
Non-Indian Proprietory Units	592	0.37
Indian Companies and Proprietory Units	115304	72.83
Total	158322	100.00

Source : Sarma, 1947

3.1.4 Labour

Initially, plantation labour belonged mostly to the densely populated parts of Travancore state and to Madurai and Tinneveli districts of the Madras Presidency. Labour recruitment was mainly with the help of agents. In the case of rubber, the involvement of native labour was higher compared to that in tea plantations from the very beginning. The tappers were mostly 'moplas' of Malabar region but the natives of Travancore and Cochin also took up this work efficiently (George *et al.*, 1988). Expansion of area under rubber and assurance of regular income made tapping more attractive when compared to other agricultural jobs.

3.1.5 Price component

With the invention pneumatic tyres and the development of several products using rubber, the demand for rubber began to raise substantially leading to the first price boom in Europe during the early 20th century. With the rubber manufacturing industry in India yet to evolve, export of rubber from India showed an upward trend and fetched remunerative prices. The high prices, along with developments in agrotechnology and availability of cheap contract labour provided a very favourable environment for rubber cultivation and more and more areas were brought under the crop.

During the course of the first World War (1914-18), the British colonial rulers imposed a ban on export of rubber to Germany which resulted in surplus stock in all rubber producing countries (Barlow *et al.*, 1994). The resultant sharp plunge in prices compelled major rubber producing countries like Malaya and Ceylon to constitute the Stevenson Committee for imposing some voluntary restrictions. As India was not covered under the Stevenson Restriction Scheme (1922-28), the area and production increased substantially during 1923-28. In 1926 alone, 22380 acres (9060 ha) were newly planted with rubber (Indian Tariff Board, 1951). This period also showed the preponderance of smallholdings in rubber and the increase in area under smallholdings was over 200 per cent compared to the near 30 per cent in the estate sector.

During the early 1930s, there was a slump in the prices of all agricultural commodities consequent to the great economic depression (1929-33) and the rubber prices also came down to an unprecedented low. To tide over this crisis, almost all the rubber producing countries including India entered into an International Rubber Regulation Agreement (IRRA) in 1934. The IRRA envisaged that further expansion of rubber in participating countries can be controlled by assigning export quotas and strictly restricting replanting and new planting (McFadyean, 1944). The Indian Rubber Licensing Committee was formed for the enforcement of the IRRA in India under the Indian Rubber Control Act, 1934. Under the protection offered by the IRRA, the price of rubber began to rise and the area increased only up to the extent permitted. The IRRA which was originally intended for control from 1 June 1934 to the end of 1938 was extended several times and finally terminated on 30 April 1944.

The restriction on expansion of rubber cultivation in India under IRRA was, however, practically nullified since 1942 as a result of the conquest of Malaya and other South East Asian colonies by Japan during the second World War (1939-45) and only India and Ceylon

remained as the sources of natural rubber for Britain and allied countries. The Indian Rubber Production Board was constituted in 1942 by the issue of the Rubber Control and Production Order under the Defence of India Rules. All restrictions on production and planting of rubber were thus removed and planters were encouraged to maximize production by all means. A renewed interest in planting was created in 1943 and as a result another 12245 acres (4937.5 ha) were brought under rubber (Sarma, 1947).

Since the inception of the rubber plantation industry in India, the price was subject to extreme fluctuations in different historical contexts due to various socio-economic and political reasons. In 1910, growing demand resulted in a hike in prices but dropped in 1922 due to the accumulation of stock. It recovered slightly as a result of the international restrictions in 1925 but again fell drastically during the early 1930s (Sarma, 1947). In May 1942, the Government fixed statutory maximum prices for the first time in India and later in September converted the maximum prices of rubber to fixed prices. This marked the beginning of Government price regulation for rubber. The Rubber Control and Production Order, 1942 also had provision for statutory price control and a Government purchasing organization was simultaneously set up. The price control was continued till 30 September 1946 when the Rubber Control and Production Order lapsed.

3.1.6 Genesis of the Indian Rubber Board

In view of the growing demand for a permanent organization to look after the interest of the rubber industry in India on the abolition of the Indian Rubber Production Board on 30 September 1946, an ad hoc committee was created to make suitable recommendations. The Government of India as per the recommendations of the committee, passed the Rubber (Production and Marketing) Act, 1947 which came into force on 18 April 1947 and the Indian Rubber Board was created forthwith. The act was amended by the Rubber (Production and Marketing) Amendment Act, 1954 and the Board was renamed as 'The Rubber Board'.

3.2 Developments since independence

The rubber plantation industry in India since independence showed dynamic growth aided by a host of favourable factors. The most notable was the Government support initiated through the Rubber Board (George and Thomas, 1997) in the form of incentives, research and institutional support for cultivation, processing and marketing. In Kerala, many land owners were tempted to switch over to cultivating plantation crops like rubber in the context of the imposition of ceiling on ownership of landed assets consequent to the Land Reforms Legislation during the late 1950s. The growing internal demand which outstripped production as early as 1948 and Government's price stabilization measures also contributed to the production drive. The eager and receptive farmers' enterprising nature to adopt scientific methods of cultivation was another positive factor.

3.2.1 The Rubber Board

Since inception in 1947, the Rubber Board concentrated mainly on enhancing production of NR by increasing productivity and extension of cultivation to non-traditional areas, ensuring remunerative and stable prices as an incentive to growers, value addition to raw rubber through quality upgradation and development of marketing channels.

The Rubber Research Institute of India (RRII) was established in 1955 to undertake scientific research on aspects relating to production, cultivation and processing. The RRII has perfected location-specific agrotechnology covering selection of site and choice of planting material, propagation and planting techniques, plantation maintenance and intercropping, management of pests and diseases, exploitation systems, primary processing and product development for all areas in the traditional rubber growing region. The clone RRII 105, ranked as one of the best in the world in terms of realized and potential yield, is an outstanding contribution towards increasing the production and productivity of NR in India. The research results from the non-traditional areas aid in formulating appropriate location-specific agrotechnology for these regions as the crop is cultivated under suboptimal conditions.

The organized extension work began in 1949, when the Board distributed clonal seeds in 1950, 1951 and 1952 (Rubber Board, 1956). From the earnest beginning of two rubber nurseries established in 1951, one at Poonoor estate and the other at Rajagiri estate for the distribution of clonal seedlings, the Rubber Board has developed, over time, an extension network spread all over the country for modernizing rubber cultivation. The Rubber Board introduced its first Replanting Subsidy Scheme in 1957 for popularizing high yielding clones with a provision for financial incentives. This scheme was since then revised periodically, covering new plantings and replantings. Input Subsidy Scheme for small growers introduced in 1986-87 also was revised and continued. The cumulative efforts of the research and extension activities have contributed to India's achieving the highest average productivity of rubber.

The institutional framework for market support to NR industry had its beginning in the mid-1960s with the establishment of marketing cooperative societies with Rubber Board's active share participation and technical assistance. In Kerala, the Kerala State Cooperative Rubber Marketing Federation (KSCRMF) was established in 1970 as the apex organization. During the course of over three decades, the number of societies increased substantially and the aggregate membership of growers in the societies grew from 706 in 1965-66 to over 0.1 million in 1996-97. The Board also promoted the Rubber Producers' Societies (RPS) which are localized voluntary organization of rubber growers from 1986-87. The RPSs are now spread all over the country and number about 1500 in 1998. Thus, the cooperative sector became more deep rooted and by 1994-95 became the largest supplier of NR.

Organized efforts for value addition of raw rubber in India started in 1976 with the establishment of the Pilot Crumb Rubber Factory by the Rubber Board. Since 1980, six technically specified rubber (TSR) factories have been established in the cooperative sector and many followed in the private sector. From mere 2416 t in 1980-81, the TSR production in India has increased to 41110 t in 1995-96 with its relative share in total NR production in India being around eight per cent.

Although the rubber trees existed in the non-traditional areas in very limited numbers since the beginning of the 20th century, efforts towards organized planting started only after the independence. There was a demand for substantial increase in total production

of NR and the scope for area expansion in the traditional region and producitivity enhancement through short-term techniques had limitations. The viable alternative was to introduce rubber to non-traditional areas and the Board carried out extensive exploratory surveys in different states in the country and formulated schemes specific to each potential region. The crop is now successfully cultivated in Tripura, Assam, Mizoram, Meghalaya and Arunachal Pradesh in the north-eastern region, Maharashtra and Goa in the western region, West Bengal, Orissa, Madhya Pradesh and Andhra Pradesh in the eastern region. Rubber cultivation in the non-traditional regions in India increased from 1525 ha in 1950-51 to 56333 ha in 1995-96 (Rubber Board, 1997).

3.2.2 Preponderance of smallholding sector

One of the striking developments in the industry since independence was the preponderance of the smallholding sector. This growth was more pronounced during the late 1950s. Relatively remunerative price of rubber as well as the incentives provided by the Rubber Board particularly for the smallholding sector accelerated this process. When the Plantation Labour Act was promulgated in 1951, many growers were forced to limit the size of their holdings within 10 ha. These as well as division of properties under the prevailing land ownership systems resulted in fragmentation of units. The price slump of tea during 1970 led many small-scale tea growers to rubber cultivation (George *et al.*, 1988). The smallholding (below 20 ha) sector which accounted for 33.2 per cent of the rubber area in India in 1947 sharply moved to 86.1 per cent by 1996-97. From 1947 to 1996-97, the number of smallholdings below 2 ha in extent rose 68 times, the relative increase in area being 49 times.

3.2.3 Emergence of public sector plantations

Many state governments started plantations under public sector during early 1960s with the active involvement of the Rubber Board. Public sector rubber cultivation in Kerala was initiated during the early 1950s. A Rubber Plantation Department was started in 1962 for coordinating activities under various departments. When the Plantation Corporation of Kerala Ltd. was formed on 12 November 1962 as a fully government-owned company, all the rubber estates raised till then were brought under its control.

The Rehabilitation Plantations Ltd., Punalur was established in 1972 as a public sector rubber plantation with a view to rehabilitate a portion of repatriates from Sri Lanka as part of the India-Sri Lanka Agreement of 1964. The State Farming Corporation of Kerala Ltd., established in 1972, also took up rubber cultivation.

In Karnataka, the Forest Department started rubber plantations in 1961 which was later utilized for accommodating the repatriates from Sri Lanka and established as The Karnataka Forest Development Corporation Ltd. in 1981. In Tamil Nadu, the Forest Department started the Government Rubber Plantations in Kanyakumari district in 1960 which later was constituted as Arasu Rubber Corporation Ltd. in 1984.

When Tripura Forest Development and Plantation Corporation Ltd. (TFD&PC) was formed in 1976, they not only took up the already existing rubber plantations in Pathichari and Manu since 1963, but also started large-scale rubber planting. Tripura Rehabilitation Plantation Corporation Ltd. (TRPC) was constituted in 1982 for rehabilitation of tribal

shifting cultivators. In Assam, the Forest Department first took up rubber planting followed by the Soil Conservation Department. The Assam Plantation Crops Development Corporation Ltd., (APCDC), formed in 1974, was assigned with the task of large-scale expansion programmes. Rubber cultivation was also started in Meghalaya and Mizoram by the state soil conservation departments. The State Forest Department took up rubber planting in the northern districts of West Bengal in 1977. In Orissa, the Soil Conservation Department started rubber planting in 1984.

3.2.4 Price control

Statutory control for NR prices in India introduced in 1942, is being continued till date in different forms. The Indian Rubber (Production & Marketing) Act, 1947 empowered the government to fix the maximum and minimum prices. During the period up to 1968, the prices were reviewed and revised several times by the Tariff Commission based on cost studies and the mechanism provided income guarantee for the growers and avoided fluctuations in prices. In 1968, the provision for fixing maximum prices was removed resulting in wide fluctuations in NR prices.

In order to stabilize rubber prices at remunerative levels, the State Trading Corporation (STC), a public sector undertaking in 1968 under Government of India, entered directly in the rubber market. Since then, from its initial advisory role of monitoring and regulating imports of rubber, the STC has employed other market intervention measures including exports and bufferstocks. The government policies, the institutional patronage, the growing domestic consumer sector and the remunerative prices favoured dynamic growth of the industry (Burger *et al.*, 1995).

3.3 Indian rubber manufacturing industry

The early 1920s witnessed the birth of an indigenous rubber goods manufacturing industry in India entirely under the colonial patronage. In 1922, the first rubber factory in India was established in Bengal by the Dixie Ave for the proofing of fabrics and subsequently in 1923 Bengal Water Proofs was set up for the production of rubber-covered cables.

The real beginning of the rubber manufacturing industry was only during the 1930s with major foreign companies establishing infrastructural facilities as part of decentralizing production. Thus, Bata Shoe Company began operation in 1933. Indian tyre industry had its beginning in 1935 when the Dunlop Rubber Company started a factory in Bengal followed by Firestone in Bombay in 1940 (Indian Tariff Board, 1947). In addition to these foreign enterprises the Indian Rubber Manufacturers Ltd. set up a factory in 1934 for the production of railway and mechanical goods. In 1935, state-owned Travancore Rubber Factory was started. Small factories for the production of footwear and general rubber goods like tubes, hose, sheeting and cycle tyres were also established during the same period. With the entry of foreign companies and the subsequent establishment of Indian owned small-scale units, the internal demand for raw rubber in India registered a sharp increase and as early as 1947, the domestic consumption outstripped production.

During 1960s, seven more tyre factories established their units in India and there are at present 26 factories producing a variety automobile tyres. India, with its huge

manufacturing base of 5400 units and with a labour force over 0.35 million consumes even more rubber than the three major rubber producing countries. The tyre sector comprising automobile tyres and tubes, cycle tyres and tubes and retreading materials together consumes 65.35 per cent of total rubber of all forms followed by the footwear sector (14.06%). As a major shift in the policy perspective, the Government in 1993 opened the doors of the Indian rubber manufacturing sector for the multinational companies.

4. CURRENT STATUS

The organizational structure of the Indian rubber production sector is divided between smallholdings and estates, the former with 474880 ha comprising 87 per cent of the total area under rubber. Large estates constitute a small sector with only 69654 ha. Compared to other plantation crops in the country, rubber has recorded higher annual growth rate in area, production and productivity during the period between 1971-72 to 1994-95, the respective figures being 3.77, 6.92 and 3.08 per cent (George and Thomas, 1997). Today, India is the fourth highest producer of rubber in the world having a total of 554000 ha under rubber with a total production of 605045 t. More significant is India's achievements in productivity with the 1998 national average being 1549 kg per ha per year which is the highest among the major rubber producing countries.

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