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Chapter 31

Cultivation in non-traditional areas

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1. INTRODUCTION

The growing demand for natural rubber (NR) all over the world has emphasized the need for substantial increase in the total production of NR. Productivity enhancement alone cannot bridge the gap between production and consumption and the only alternative has been expansion of the area under the crop. In India, rubber cultivation till 1960s was confined to the south-west, mostly Kerala state, Kanyakumari district of Tamil Nadu and the Andaman and Nicobar Islands, located between 8 to 12°N. Scope for expansion of the crop in this traditional belt is little due to non-availability of land. The only practical solution, therefore, has been extending rubber cultivation to non-traditional regions (Menon, 1980; Menon and Unny, 1990). The attempts to grow rubber in India at 20 to 28°N and in China at 18 to 24°N have been successful, in spite of the fact that in these areas the crop faced various stress conditions. Rubber is now cultivated with appropriate research and development back up in Tripura, Assam, Meghalaya, Nagaland, Manipur, Mizoram and Arunachal Pradesh in the north-eastern region, Maharashtra and Goa in the Konkan region and West Bengal, Orissa, Andhra Pradesh and Madhya Pradesh in the eastern region.

2. HISTORY

Rubber cultivation was initiated in various states by the erstwhile Maharajas, administrators and plantation owners since the beginning of the 20th century. In Cachar district (Assam), trees planted in 1913, which are robust and having girth in the range of 125 to 525 cm, still exist. In Meghalaya, the earliest planting dates back to 1950s and that in Tripura to 1960s.

Organized attempts in rubber planting in the north-eastern region was initiated by government agencies during the 1960s. The first large-scale rubber planting in Tripura was by the State Government in 1963 (Krishnakumar, 1990). The Soil Conservation Departments in Mizoram, Meghalaya and Assam also started plantations during the same period. A public sector undertaking (Tripura Forest Development and Plantation Corporation Ltd.) was formed in 1976. The Soil Conservation and Forest Departments in other states also took up rubber planting during this period.

Rubber as a crop for rehabilitation of tribals, to wean them away from the ecologically damaging practice of shifting cultivation was considered in the 1970s in the north-eastern region. In Tripura, a few tribal families were settled in rubber plantations in 1977. The Tripura Rehabilitation Plantation Corporation Ltd. (TRPC) was constituted in 1982 for settlement of the tribal shifting cultivators. The Assam Plantation Crops Development Corporation Ltd. for settlement of tribals was set up in 1974. These projects aim at handing over the plantations at the yielding stage to the tribals while they are wage earners during the immaturity period.

In the Eastern India, rubber cultivation was taken up in Orissa in the 1920s (Rubber Board, 1986). A 6 ha plantation was raised in Mayurbhanj by the Maharaja. Trial plantations were taken up by the State Soil Conservation Department during 1966. In Andhra Pradesh initial planting was taken up in East Godawari district by the Forest Department during 1969. The planting material was polyclonal seedlings and the productivity reportedly exceeded 1 t per ha (Krishnakumar, 1995). Plantations in the northern districts of West Bengal were started during 1977 by the Forest Department. The Rubber Board has undertaken trial plantations at Sukma in the Bastar district of Madhya Pradesh during 1990.

In Western India, rubber has been in existence from the 1960s (Narayanan, 1986). During 1925, the Portuguese raised plantations in Sanguem in Goa on a trial basis. The Maharaja of Sawantawadi also planted rubber at Danoli in South Konkan during the same period (Das and George, 1975). The State Forest Department started rubber plantation activities in Maharashtra in 1960 and the Development Corporation of Konkan took up large-scale planting in 1986. The Rubber Board started a trial plantation in Maharashtra in 1981 (Chandrashekar, 1983).

Rubber cultivation in all these areas was mostly confined to a few public sector plantations till late 1970s. The crop, however, attracted public attention and the package of incentives offered by the Rubber Board, contributed to the expansion of area in the smallholding sector. The specific scheme for accelerated development of rubber plantation for the north-eastern region and the eastern region since 1984-85 resulted in real expansion, particularly in the smallholding sector.

3. CURRENT STATUS

The total extent of rubber cultivation in the non-traditional areas in the north-eastern, Konkan and eastern regions in India is over 40000 ha, the production being above 4000 t (Rubber Board, 1999), the relative contribution in the country's total area being 7.5 per cent. The share in production is less than one per cent, but will be on the increase as and when more plantations come into tapping. Planting activities, especially those in the north-eastern states, are on the increase.

4. RUBBER BOARD'S PROMOTIONAL ACTIVITIES

The Rubber Board has been promoting rubber cultivation in the non-traditional locations by offering various incentives, research support, developmental packages and extension whicn have contributed substantially in creating awareness and bringing new areas under the crop.

4.1 Research

4.1.1 Infrastructure

Rubber cultivation under agroclimates which are non-conducive demands identification of appropriate agrotechnologies suited for each region. With this in view, research activities were initiated with the establishment of Regional Research Stations (RRS) in various agroclimatic zones. The first RRS was established in Tripura in 1979 and subsequently in other states too (Table 1). In the north-eastern region, the research efforts are coordinated at the North Eastern Research Complex, established in 1985.

Table 1. Regional research stations of RRII in non-traditional regions

Station	State	Year of establishment	Location of experimental farm
RRS, Agartala	Tripura	1979	Taranagar
RRS, Guwahati	Assam	1985	Sorutari
RRS, Tura	Meghalaya	1985	Ganolgre and Darachikgre
RRS, Kolasib	Mizoram	1985	Tuichuan
RRS, Nagrakatta	West Bengal	1989	Nagrakatta
RRS, Dhenkanal	Orissa	1987	Kamakhyanagar
RRS, Sukma	Madhya Pradesh	1989	Sukma
RRS, Dapchari	Maharashtra	1981	Dapchari

4.1.2 Priorities

The research priorities identified in general are crop improvement and evolving suitable agromanagement practices such as planting technique, fertilizer management, diseases and pests management, exploitation systems and rubber-based sustainable cropping systems. The impact of rubber cultivation on the ecosystem is also under study. Location-specific research aimed at developing appropriate package of practices for the respective area is carried out in each station and emphasis is given to problems which require immediate attention. Crop improvement programmes including biotechnological investigations, agromanagement practices and exploitation systems are the priority areas in

Tripura. In Meghalaya, the thrust is on physiological aspects in relation to high altitude situations, while that in Mizoram is development of rubber-based farming systems. Plant protection and planting material evaluation are the thrust areas in Assam. Development of agromanagement practices suitable for climatic extremes is given emphasis in Orissa while in Maharashtra the thrust is on drought management.

4.1.3 Research highlights

Local constraints often limit growth and productivity. The package of practices applicable to the traditional areas, in most cases, are not relevant when the crop is grown under stress conditions. Valuable information has been generated at each RRS on growth and productivity. This could aid to evolve specific agromanagement practices for the location as well as for other locations subjected to comparable constraints which, however, require years of experimentation. Nevertheless, it has been possible to draw certain guidelines for rubber cultivation under suboptimal conditions based on the limited data and information available.

4.1.3.1 Propagation and planting

Green budding was more successful than brown budding in Tripura recording 90 per cent success from February to June and the observation is valuable in preparation of advanced planting materials in the north-eastern India. Chilling injury for young plants in Tura was substantially higher (83%) for plants in polybags compared to those in the field (9%) indicating that the root system is likely to be more affected under very low temperature (Sethuraj *et al.*, 1991). From the field establishment point of view, the best form of planting material is two-month-old polybag plants while 14-month-old green-budded polybag plants were better in terms of growth in Tripura (Potty *et al.*, 1991). Mulching in seedling nurseries reduces the impact of soil moisture stress and black polythene mulch increases soil temperature during winter in the north-east compared to white polythene and organic mulches (RRII, 1992). Budded stumps in polybags maintained inside polyhouses show substantially higher percentage of bud sprouting and better growth compared to those maintained outside (RRII, 1992; 1996) and is a useful technique to tide over the low winter temperature.

4.1.3.2 Planting material

Growth behaviour and clonal performance are highly variable under varying agroclimates. Among 15 clones tried in Tripura, RRIC 105 recorded better growth performance (RRII, 1989). Based on adaptability, clones RRIM 600, PB 86 and GT 1 appear to be widely adapted to different seasons, compared to RRII 105, which is specifically adapted to summer season (Meenattoor *et al.*, 1991). The clone RRII 118 also holds promise in terms of growth. The overall growth inhibition compared to that in the traditional region is 20 per cent (Sethuraj *et al.*, 1991). In general, about 20 per cent of the annual growth is contributed during winter, RRII 118 recording the maximum (27.46%) in Tripura (Vinod *et al.*, 1996). Haiken 1, the Chinese clone and RRII 208 also show better growth during winter (Priyadarshan *et al.*, 1996).

Clones like RRIC 105 and RRII 105 were found to be early wintering (Vinod *et al.*, 1996). The flowering pattern also is found to vary (Meenattoor *et al.*, 1989). The clones PR 107 and PB 5/51 are windfast (Priyadarshan *et al.*, 1996; Vinod *et al.*, 1996). In Tripura, the yield during the first three years of tapping was highest for PB 235 followed by RRIM 600 and the incidence of tapping panel dryness (TPD) was comparatively higher in RRIM 600 (Vinod *et al.*, 1996). The initial yield of Haiken 1 and RRII 208 appears to be good (Priyadarshan *et al.*, 1996). In Assam, RRIM 600 and RRIC 102 showed satisfactory growth and the initial yield was higher for RRIM 600 (RRII, 1997).

Physiographic features, especially orientation of slope, also influence growth. Girth of trees on the south-facing slope is significantly higher than on the north-facing slope in Meghalaya. During winter months perceptible difference in temperature between north- and south-facing slopes occurs, the latter being warmer (Saseendran *et al.*, 1993b).

In the Konkan region, RRIM 600, RRII 6 and RRII 208 show higher growth indicating better adaptability to stress (Nazeer *et al.*, 1992; Chandrashekar *et al.*, 1994; 1998). RRIM 600 is also yielding high in this region (RRII, 1997). In Orissa, the clones RRIM 600 and GT 1 and trees raised from polyclonal seedlings perform better in terms of early growth (RRII, 1997).

4.1.3.3 Soils and nutrition

Soils, especially in the north-eastern region, are highly degenerated due to 'jhumming' (shifting cultivation), which is preceded by the burning of organic debris. Weeds like *Imperata cylindrica* ('lalang' or thatch grass) remove nutrients considerably. These necessitate higher inputs of fertilizers, especially N. Proper scheduling of fertilizer application based on the rainfall pattern is also important, particularly during the immature phase of rubber (Krishnakumar and Potty, 1989a). The soils in Tripura, in general, are very deficient in available P, low in organic C, medium in K and high in Mg contents (Krishnakumar and Potty, 1989a,b). Experiments with graded levels of P and K indicate that application of higher doses of nutrients resulted in their increasing soil availability and leaf nutrient contents (Krishnakumar and Potty, 1989a; Philip *et al.*, 1993). Application of K also influences plant growth during winter and irrigation helps in mitigating the deleterious effect of stress to certain extent (Philip, 1997).

Form and placement of fertilizers also influence growth of rubber. Application of water soluble P for the first two years and water insoluble P for the remaining period influence growth positively. Deep placement of fertilizer is better compared to other systems, during the immature phase (RRII, 1992). Moreover, placement of fertilizers significantly influences root growth pattern, which also has a bearing on the soil microflora (Deka *et al.*, 1998). The demand of nutrients varies with the type of planting material. Higher dose of fertilizers is warranted for plants in polybags (Krishnakumar and Potty, 1989a). The organic matter build up increases due to low rate of nitrification as the trees become older (Rao *et al.*, 1990).

Root distribution is higher at a horizontal distance of 200 cm from the plant base. Root and nutrient concentrations are higher in the top 18 cm layer in the vertical plane (Philip *et al.*, 1996). Higher doses of N exert positive effect on growth, while higher doses of P and K do not have such influence on rubber in Assam and West Bengal (RRII, 1997). The soil of Dapchari has high content of manganese, but may not cause any adverse effect on growth of rubber (Karthikakuttyamma *et al.*, 1989)

4.1.3.4 Water requirements

Irrigation along with shade, influences growth of rubber seedlings in the nursery. Under shade, the frequency of irrigation can be reduced from once in three days to once in 10 to 12 days under Tripura conditions (RRII, 1992). Climatic data for eight years reveal that drought condition exists during March to May in Tripura in certain years and supplementary irrigation may be necessary for field plants. The irrigation requirement is about 25 L per tree per day (Saseendran *et al.*, 1993a).

Severe inhibition of photosynthesis and transpiration, due to moisture stress, occurs in North Konkan (Chandrashekar *et al.*, 1990; Mohanakrishna *et al.*, 1991). These can be alleviated through partial irrigation during the summer months (Chandrashekar *et al.*, 1994). Deep irrigation increases stomatal conductance (RRII, 1992).

Under stress situations, as in the case of North Konkan, irrigation is essential for trees in the field to maintain optimum growth. Irrigation during dry months could contribute substantially to growth (50% of that in wet season) whereas unirrigated trees fail to grow (Bhaskar *et al.*, 1990). Immaturity period in this region can be reduced to six years by providing adequate irrigation which results in better growth performance in the dry season than in the wet season (Vijayakumar *et al.*, 1998). In the absence of irrigation, extreme soil and atmospheric moisture deficits result in very low plant moisture status, a high plugging index and consequently low and uneconomic yield (Chandrashekar *et al.*, 1993).

Mulching and shading can reduce the water requirement in the Konkan region (RRII, 1990). Contact shading of polybag plants using 10 per cent china clay spray can effectively replace conventional shading with coconut leaf basket and is three times cost effective (RRII, 1989; 1992).

4.1.3.5 Cultural practices

'Lalang' is a noxious weed competing with young rubber plants in most rubber areas in the north-eastern region. It can be controlled economically by spraying glyphosate. However, follow up spraying with paraquat is necessary if the weed infestation is severe (RRII, 1992; 1997).

Pueraria phaseoloides is widely recommended as cover crop in north-eastern region. A locally existing ground cover *Mucuna bracteata* (Panikkar, 1981), though not recommended as cover crop for the north-eastern region, grows well in Meghalaya (Deka *et al.*, 1991). It is popular in the traditional rubber growing tracts of India.

4.1.3.6 Diseases and pests

Most of the diseases and some of the pests that occur on rubber in the traditional belts are noted in the non-traditional areas, but the extent of damage and order of importance vary. In all the states in the north-eastern region, powdery mildew disease is the most severe one (RRII, 1987; Mondal *et al.*, 1998b).

Widespread occurrence of *Gloeosporium* leaf disease on nursery plants in Assam, Meghalaya and Tripura, abnormal leaf fall caused by *Phytophthora* in Tripura, *Corynespora* leaf disease in Assam and Meghalaya and mild incidence of *Colletotrichum* leaf disease in Assam, Meghalaya and Mizoram are reported (RRII, 1991; Mondal *et al.*, 1994; Singh *et al.*, 1998).

Periconia leaf disease, a very minor disease (Mehrotra, 1988), is gaining importance in Assam (Mondal *et al.*, 1998a). Pink disease was noticed in Assam, Tripura and Meghalaya and bark rot disease in the latter two states (RRII, 1991; Deka *et al.*, 1998). Brown root disease occurs in some of the areas in this region but the intensity is very mild (RRII, 1997).

Scale insects cause severe defoliation during June to August in Tripura and in the winter months in Assam. Termite infestation is noticed in plantations in the north-eastern states (RRII, 1991). In Orissa, the problem is more serious warranting control measures (RRII, 1992). *Hypomeces squamosus*, a weevil, causes damage to budwood plants in Assam (Mondal *et al.*, 1995). Slug and snail infestation is a minor problem in Assam. Root grub (*Anomala* spp.) infestation is severe in Orissa (RRII, 1991). Diseases and pests management strategies for rubber in non-traditional areas are the same as in the traditional zone with minor modification.

4.1.3.7 Ecological impact

Rubber plantations, adopting proper agromanagement practices, help in the enrichment of soil organic matter which consequently improves physical properties such as bulk density, soil porosity, moisture retention and infiltration (Krishnakumar *et al.*, 1990). Further, the available water storage capacity of soils under rubber is higher than that under *Acacia* and shifting cultivation. The build up of biomass, microflora and understorey vegetation in rubber plantations is comparable to that in teak plantations (Krishnakumar *et al.*, 1991) indicating ecological desirability of rubber in terms of habitat diversity, soil physical properties and nutrient recycling.

Rubber also helps significantly to moderate soil temperature, air temperature and other micro-morphological parameters. During midday, soil temperature inside the plantations is 10.6°C less compared to that in open area outside (Krishnakumar *et al.*, 1991).

4.2 Development

In addition to the agroecological constraints, development of rubber plantations in non-traditional regions, particularly the north-east, confronts various limitations such as lack of technical knowledge among growers, poor infrastructure, lack of availability of institutional finance, inadequate extension support, poor financial condition of the potential growers, lack of availability of high yielding planting materials, peculiar land tenure system where individual land titles are not available, provisions of the forest conservation act preventing planting of rubber even in denuded areas and frequent socio-political disturbances. The Rubber Board's strategies for plantation development were therefore reoriented for the non-traditional regions. The Board has built up an extensive package for extension activities and implementation of the development schemes, and is coordinated by its Rubber Production Department to cover all such regions.

4.2.1 Infrastructure

The Board started its extension activities in the non-traditional regions in 1967 with the setting up of a Field Office in Tripura, which was upgraded to a Regional Office in 1979. Regional Offices were also established in various potential regions in the country during 1980s. During the same period, Regional Nurseries, District Development Centres

(DDC), Tappers' Training Schools (TTS) and Field Stations were opened on a need-based manner. The Nucleus Rubber Estate and Training Centre (NRETC) established in Tripura provides on-farm training to all categories of personnel involved in rubber plantation sector on all technical aspects of cultivation and processing.

The present set up in North East India consists of two Zonal Offices (Guwahati in Assam and Agartala in Tripura), eight Regional Offices (Guwahati, Silchar, Diphu and Jorhat in Assam, Tura in Meghalaya, Agartala, Udaipur and Dharmanagar in Tripura), the NRETC near Agartala, three DDCs (Mijumdisha and Darrangiri in Assam and Jenggitchakgre in Meghalaya), six TTS and 19 Field Offices.

The eastern region is catered by a Zonal Office at Bhubaneswar in Orissa, three Regional Offices (Bhubaneswar, Baripada and Parlakhemundi) and two Field Offices (Dhenkanal and Maredumilli). In the Konkan region, there are two Regional Offices (Kundapura in Karnataka and Ponda in Goa) and three Field Offices (Khed, Sagar and Thirthahally). Seven Regional Nurseries established in the non-traditional rubber growing tracts generate the planting material for each region concerned.

4.2.2 Schemes

The Rubber Plantation Development (RPD) scheme envisages the grower to undertake all operations including planting initially and then apply for availing the planting grant. Planting grant is released based on growth performance. Since the potential growers in the non-traditional regions are mostly poor with very low technical know-how, undertaking the plantation development work is difficult. Therefore, many schemes for the traditional zone were made more attractive by appropriate modifications to suit each region. In addition, need-based specific new schemes were also introduced for accelerated plantation development activities.

4.2.2.1 Finance and inputs

Under the RPD scheme, Rs. 22000 per ha is given as subsidy to growers having up to 5 ha and Rs.18000 per ha to those having plantations up to 20 ha. Polybags and budded stumps are supplied in advance to growers owning up to 5 ha. For use of polybag plants, Rs. 3000 per ha is provided as assistance for growers under general category and Rs. 4000 per ha for those belonging to Scheduled Castes/Tribes (SC/ST). Fifty per cent of the cost of fertilizers for the first three years of planting is also provided for the latter. The scheme for developing irrigation facilities for rubber provides financial assistance of Rs. 5000 per ha subject to a maximum of Rs. 50000 per holding. The small and marginal farmers are assisted in providing boundary protection for plantation through a scheme which offers up to Rs. 4000 per ha. Another scheme provides inputs for boundary protection free of cost to SC/ST growers who plant rubber under the RPD scheme. Assistance up to Rs. 5000 is provided for constructing smoke houses. The transporting and handling cost of all farm inputs for rubber growing are met by the Board and the inputs are supplied at cost price. Individual growers are eligible for an assistance of Rs.1000 for purchase of hand-operated sheeting rollers. Rubber rollers for sheet making are supplied free of cost to voluntary organizations or groups of 15 to 20 growers. For construction of community processing shed and smoke house, the total assistance is Rs. 200000.

4.2.2.2 Planting material generation

One of the major constraints during the initial period of rubber cultivation in non-traditional regions was the non-availability of quality planting materials. To tackle the situation, the Board has established own regional nurseries (Plate 74. a-c) in Tripura (Tulakona, Rangutia), Assam (Darrangiri, Hillara, Mijumdisha), Meghalaya (Mendipather) and Andhra Pradesh (Devarapally). The Board has also promoted nurseries in private sector. In addition, through a special scheme, private nurseries were also sponsored by the Board.

4.2.2.3 Tribal rehabilitation

The economic settlement project for rehabilitation of tribal shifting cultivators was initiated in 1970s. Success to the extent desired could not be achieved and therefore, in 1992, the Board took up a project adopting an integrated approach covering an area of 1500 ha in collaboration with the Government of Tripura for rehabilitating 1000 families. Similar schemes were extended to Orissa in 1994 and Andhra Pradesh in 1995.

4.2.2.4 Group approach

The highly scattered nature of smallholdings, poor infrastructure facilities and other infirmities make extension support to growers to the desired extent difficult. To overcome this, the RPD scheme, with certain modifications, is implemented on group basis where the beneficiaries in a village are formed into a group and the various assistances are channelled through the group. The group activities begin with land preparation with common polybag nurseries for which input materials such as polybag, bud-grafted stumps, *etc.* are provided in advance, and all cultural operations are carried out under the close guidance of the extension officers of the Board. The scale of financial assistance, however, is not significantly different. The Board, nevertheless, liaises with the concerned agencies and a preferential channelization of existing development schemes of the Central as well as of the State Government is ensured to the project areas providing additional financial support to the growers. This approach has made very good success and would be extremely beneficial in the long-run as promotion and sustenance of the group would help to establish community processing and marketing.

4.2.2.5 Block plantation

In most of the non-traditional regions, particularly Andhra Pradesh, Orissa and the states in the north-eastern region, where potential areas for rubber expansion have been identified, the majority of the population is tribals. Tribals are used to the primitive agricultural practice of shifting cultivation, locally called 'jhumming'. Historically shifting cultivation represented a rational agricultural practice without any negative impact on the environment, but subsequently when the pressure on land increased, the 'jhum' cycles got reduced and as a consequence the impact on environment has been damaging. The income from 'jhum' cultivation also was not even adequate to meet the basic needs of the tribals. To overcome this, the various state governments initiated rehabilitation projects for offering economic settlements to tribals. The lands were parcelled out and the hillocks suitable for rubber were divided and allotted to groups of 50 to 100 families each. The attempts have not been effective and the tribals went back to forests and resorted to shifting cultivation. In 1970s, attempts were made by the state governments for offering economic settlements for tribals with rubber as the major activity. However, these projects did not adopt an integrated approach and hence did not deliver the desired results though it made an awareness that rehabilitation with rubber-based settlement schemes is a possibility to be seriously reckoned.

The Rubber Board took up a pilot project in 1992 to cover 1500 ha for the economic rehabilitation of shifting cultivators in collaboration with Government of Tripura, with rubber as the major activity. The scheme was very successful and the model has been adopted by the Governments in Orissa, Andhra Pradesh and Assam.

Group plantation approach for tribal development has also been adopted by the Governments of Karnataka and Kerala. The scheme envisages taking over the land from the tribals for a period of seven years, engaging them as wage earners and handing over the plantation back to the beneficiaries on attaining tapping phase. During the course of project implementation, promotional activities are vigorously pursued and strong groups also emerge which ultimately help in carrying out processing, marketing, *etc.* The group approach along with various other components help social development including empowerment of women. Ecological considerations are taken care of by rubber plantations with luxuriant ground cover. Fuel wood needs are also considered for which fuel wood species are also cultivated.

4.2.2.6 World Bank-assisted Rubber Project

The World Bank-assisted Rubber Project being implemented by the Rubber Board aims at bringing 12000 ha under rubber in the non-traditional region. The project has a tribal development plan (TDP) for Tripura to involve women and tribals in planting and additional income generating activities like intercropping, horticulture, pisciculture, piggery and social forestry.

4.2.3 Impact

The integrated developmental approaches for rubber cultivation proved to be quite successful and large areas were covered under the smallholder sector in various states in the non-traditional areas. The number of smallholdings increased from 932 in 1983 to 30645 by 1995. There was a threefold increase in the area under rubber from 1983 to 1998 (55350 ha). In Tripura, gestation period of 10 years for 1979 plantings was brought down to seven years for 1984 plantings (Joseph and Rajasekharan, 1991).

Restoration of ecological balance through rubber cultivation has been noteworthy. The crop has also changed the lifestyle of villagers and tribals.

4.3 Processing and marketing

The Board's schemes for promoting processing and marketing of rubber such as providing assistance for sheeting rollers, tools for tapping, implements for processing, smoke houses, community processing centres, *etc.* are implemented in the non-traditional regions also. Almost all the rubber areas in the non-traditional regions are closer to consuming centres and as a result better price is realized. There is a good number of licensed dealers who assist in marketing of rubber. In addition, the Board has prompted one of the companies in the joint sector to operate in the remotest areas where smallholders are likely to be deprived of the market price. Prices realized in Tripura through the existing market channels are reasonable (Joseph and Rajasekharan, 1991). There have been changes in the marketing channels with the entry of Rubber Producers' Societies and joint sector companies in the field, with improvement in the farm gate price.

5. PROSPECTS

Exploratory studies undertaken by the Board reveal immense scope (Table 2) for cultivating rubber in the non-traditional areas in India, in spite of agroecological constraints like drought, low temperature (Rao and Vijayakumar, 1992) and hailstorm (Meenattoor *et al.*, 1995). It is very reasonable to hope that a sizeable portion of the potential area will gradually be brought under the crop so that the production therefrom will raise the country's total NR output.

Table 2. Prospects for expansion of rubber cultivation in non-traditional areas

Region	Agroecological constraints	Potential area	
		State	Extent (ha)
North-east	Low winter temperature; non-conducive rainfall pattern; low relative humidity; occasional hailstorm (Plate 74. d); highly degenerated and nutrient deficient soil; landslide	Tripura	100000
		Assam	200000
		Nagaland, Manipur and Meghalaya	100000
		Mizoram and Arunachal Pradesh	50000
Konkan region	Prolonged drought; high summer temperature	Goa and Maharashtra	100000
		Karnataka	150000
Eastern region	High summer temperature; drought, *etc.*	Madhya Pradesh	100000
		Orissa	200000
		Other States and Union Territories	100000

Promotion of rubber cultivation in non-traditional regions have other benefits as well. Rubber plantations help in generation of rural employment, assets and permanent sources of income, development of land-based activities without huge investment and eco-restoration. The potential areas are mostly denuded land devoid of any tree cover and such lands are available in remote areas closer to forest where the owners or occupants are mostly tribal shifting cultivators. Rubber plantations in such areas help in providing the much needed tree cover and offer viable permanent rehabilitation. The desirability of rubber plantations in achieving eco-restoration (Plate 74. e) is clear (Krishnakumar *et al.*, 1990; 1991). Moreover, some of the states in the non-traditional regions have vast potential for development of industry where resources such as natural gas are readily available and labour is abundant and competitive. The availability of a strategic raw material like rubber can revolutionize the industrial sphere and aid accelerated development of the regions.

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