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RESEARCH PROGRAMMES IN THE ECONOMICS DIVISION: A REVIEW

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This paper is a review of the research programmes undertaken in the Economics Division of Rubber Research Institute of India (RRII) which are broadly classified into five thrust areas, *viz.*, (i) farm management; (ii) primary processing and marketing of natural rubber (NR); (iii) rubber products manufacturing industry and foreign trade; (iv) inter-crops and by-products; and (v) inter-divisional collaborative projects. In all the five thrust areas, the primary focus had been on the development of a conceptual basis to define the basic issues confronting the NR sector and allied areas. This preparatory work has been followed up by generation of a reliable and comprehensive database so as to provide relevant policy inputs based on initial assessments and short-term evaluation studies. In the farm management sector, the four major agro-management issues identified for appropriate research and development efforts were: (i) responses of the planting community to the post-reforms scenario with serious implications on the long-term yield potential; (ii) sustainability of NR cultivation in the agro-climatically marginal lands and the need for an agro-climatic zoning; (iii) the policy questions on increasing NR production or maximizing net farm income having a bearing on the monoculture status of NR cultivation; and (iv) compatibility of the prevailing institutional support mechanisms with the current and emerging issues. The results of the studies on primary processing and marketing highlighted: (i) the relationship among capacity utilization, average cost of processing and profitability in the block rubber processing industry; and (ii) the trend and pattern of NR price movements in India and the major factors in influencing the price movements during the pre-and post-reforms phases.

The results of the studies related to rubber products manufacturing industry and foreign trade exposed the factors contributing to the historical polarization of the raw material base and the value added rubber products manufacturing base. The pioneering comprehensive study on the implications of WTO Agreement on the Indian NR sector was an attempt to analyse the potential implications in the context of trade policy measures initiated by the Government of India since 1995. The studies on inter-crops and by-products were concerned with generating adequate information on the inter-cropping practices by the smallholdings, factors influencing the inter-cropping pattern to highlight the need for the commercial exploitation of the by-products. A pioneering study on the estimation of timber yield potential of three *Hevea* clones in India suggested the need for a multi-disciplinary approach for assessing the region and clone-specific latex timber potential of the popular as well as pipeline clones. The inter-divisional collaborative projects were primary focused on the economic evaluation of the findings of other divisions of RRII from a long term research and development perspective.

INTRODUCTION

Normally, the research and development priorities on any individual crop, at a given point of time, will be designed to achieve certain specific objectives from a long-term perspective. However, an integral component determining the compatibility of the research priorities vis-à-vis the desired goals is the

short-term preparatory work which provides the basis for formulation and sequencing of long-term priorities. Functionally, any divergence from the observed complementary relationship between short-term preparatory work and long-term research priorities may lead to an explicit detachment of research output from the operational level issues of the crop concerned. The consequent contradictions will be too costly to salvage as the core competencies evolved through research and development over time is a knowledge-intensive activity with inherent limitations for in-built flexibility and reversibility. In the broad spectrum of agricultural research, adverse effects of such contradictions will be more severe in the case of perennial crops compared to annual crops due to higher initial investment, longer gestation period and economic life. This peculiar dimension of perennial crops assumes more conceptual relevance if the crop concerned invariably demands an intersection of interdisciplinary research. Nevertheless, research priorities on the same crop may vary across countries and regions depending on broad macro economic policy, compatibility of perceived goals with financial implications, strategic commercial importance of the crop to the producing country, the extent of dependent population on the crop, specific characteristics of the production sector, domestic and external market dimensions, specific biological traits, agronomic requirements etc. In this broad conceptual background, a review of the research programmes undertaken in the Economics Division of the Rubber Research Institute of India is attempted so as to assess their compatibility with the contextually-specific issues and policy priorities. Therefore, the review is conceived in the specific context of the salient features of the natural rubber (NR) sector and the explicit policy priorities which had been pivotal to the evolutionary dynamics.

SALIENT FEATURES OF THE NR SECTOR

At the outset, it is important to note that the salient features of NR sector in India which crystallised over time have been unique for specific reasons. Although the initial structure and organisation of production of rubber plantations in India were similar to other 'rubber plantations enclaves' developed by the European colonial powers in Malaysia, Indonesia and Sri Lanka, there were at least three important distinct features which had been crucial to the subsequent developments and the attendant policy and research priorities on the NR sector in India. First of all, the regional concentration of NR cultivation in the state of Kerala from the very beginning with its region-specific factors had been conducive to the subsequent dynamic transformation of the sector. Even today, the estimated share of Kerala in total area under NR cultivation and production in the country are 85 and 92 per cent respectively. Secondly, compared to other major NR producing countries, there was an active involvement of the native peasantry in the NR cultivation and as early as 1946 almost 73 per cent of the total area under the crop was controlled by the Indian companies and proprietary concerns (George, 1999a). Subsequently there has been a progressive structural devolution leading to the dominance of the smallholdings in NR production since the late 1950s. Finally, India has been maintaining the unique advantage of a captive domestic market since the late 1930s compared to other major NR producing countries (Mohanakumar and George, 1999). Today, India is the fourth largest consumer of NR in the world with an estimated total value of output of more than US $3125 million and the export earnings of value added rubber

products is estimated to be more than US $345 million in 2000-01 (George, 2002).

POLICY PRIORITIES

The achievements in the NR production and rubber products manufacturing sectors have been the result of a well co-ordinated and comprehensive policy package targeted at the stages of cultivation, processing, primary marketing and rubber products manufacturing since 1947. The policy initiatives in the NR sector had been primarily moulded in the background of the broad macro economic policy framework focusing on import substitution and self-sufficiency in all spheres of production. Accordingly, the perceived objective of self-sufficiency in NR production by resorting to both extensive and intensive cultivation was pursued without any major reversal so as to cater to the requirements of a growing domestic rubber products manufacturing industry during the 45 year period between 1947-1991. This process of maintaining a harmonious relationship between producing and consuming sectors under the protected policy regime had been unique for the notable gains in the spheres of NR production and rubber products manufacturing compared to other major NR producing countries. The genesis of the operational level achievements has been sustained research and development efforts prioritising crop improvement, development of region-specific agro-technologies, introduction of improved cultural practices, quality upgradation of raw rubber, innovations and logistic support to the rubber products manufacturing industry in tandem with the policy packages over time. The cumulative effect of the research and development efforts and institutional interventions had been the development of a rubber sector with strong inter-sectoral linkages under a protected policy regime.

However, the launching of economic reforms in India since 1991 (especially reforms pertaining to external trade) posed serious challenges to the prevailing equations not only among the sub-sectors within the rubber sector but also the compatibility between the new policy regime and the research and development priorities. The new challenges highlighted the need for considerable restructuring and strategic shifts in the research and development priorities as all the sub-sectors have been increasingly exposed to external competition compared to the erstwhile status of insularity. Functionally, the new policy changes underlined the need for a shift from the self-sufficiency criteria irrespective of the costs involved to relative economic viability of various sub-sectors within the rubber sector. Therefore, in the growing process of market integration, it is crucial to define the inherent strengths and inherited deficiencies of the various sub-sectors so as to provide meaningful guidelines for re-prioritising the interdisciplinary research and development efforts. Though the Economics Division was formally established as a constituent part of the Rubber Research Institute of India only in 1986, earnest attempts have been made to identify and define the basic challenges in the emerging scenario with a broad classification of its thrust areas of research. In the succeeding sections of this paper, a review of the major findings and observations based on the research programmes undertaken are presented with a view to generate critical comments and inputs for necessary modifications in the research priorities.

THRUST AREAS

From an analytical angle, the reported and ongoing research projects undertaken in the Division can be classified into five broad

areas, viz., (i) farm management; (ii) primary processing and marketing of NR; (iii) rubber products manufacturing industry and foreign trade; (iv) inter-crops and by-products; and (v) inter-divisional collaborative projects. However, functionally, there have been three sub-divisions in each broad area which are closely related to the nature of the projects initiated. This classification refers to long-term comprehensive research programmes, continuous studies pertaining to monitoring of relevant trends in individual areas and short-term case studies and assessments. In this review of research highlights, priority is accorded to the findings and observations having operational level relevance to the major sub-sectors of the NR sector.

Farm management

From the very beginning, the Division has been primarily concerned with studies related to economic aspects of NR cultivation and its allied areas. The main objectives of the studies initiated had been to identify the basic trends and issues so as to build a realistic conceptual basis, generating a reliable comprehensive data base and critical assessments and short-term evaluations with relevant policy inputs.

Basic studies

The conceptual constructs developed on the NR production sector have highlighted the underlying factors behind the dynamic growth of rubber cultivation in India, its consequences and contradictions in the context of the growing process of market integration since the early 1990s. While the region-specific factors relevant to the state of Kerala supplemented by colonial patronage had been more prominent in the growth of the NR production sector during the pre-independence phase, an explicit pro-active government intervention at various stages of operations dominated the post-independence phase (George *et al.*, 1988a; George and Thomas 1997; George, 1999a; Lekshmi and George, 2002). The widely recognised achievements of the dominant rubber smallholding sector in India have been characterised by a commendable response to the adoption of prescribed agro-management practices by a highly receptive planting community leading to steady improvements in yield. The extent of adoption of indigenously developed high yielding variety of planting material by the smallholdings has been higher compared to the estate sector (Joseph and Haridasan,1991; Veeraputhran *et al., 1998*). However, the impetus for expansion of area under NR cultivation beyond the traditional rubber growing regions of Kerala and Tamil Nadu primarily centred around the entry of public sector corporations owned by the state governments in Karnataka and North-Eastern States since the 1960s (George *et al.*, 1988a). Thus the propulsion of growth in area under NR has been maintained in the traditional belt by the smallholdings while the breakthrough for the same was made by public sector corporations in the non-traditional regions. Despite this sectoral divergence in the growth of NR cultivation between the traditional and non-traditional regions, the institutional support mechanisms evolved till the early 1990s had been progressive and compatible with the perceived objective of achieving self-sufficiency in NR production. Though the major institutional support mechanisms such as planting subsidy, input subsidy, processing and marketing support and explicit controls on external trade had been subjected to appropriate modifications at different historical contexts, the centripetal force which maintained the tempo of growth in area and production during the period between 1947-91 had been the price policy

which ensured the relative profitability of NR cultivation (George *et al.*, 1988a; George, 1999a). The three integral components of the price policy were declaration of statutorily notified minimum prices, insulation of domestic prices from the vagaries of external price fluctuations through tariff and non-tariff barriers on NR imports and promotion of group marketing through co-operative rubber marketing societies since the 1960s (George and Chandy,1996).

The cumulative impact of research and development efforts, institutional support mechanisms at various spheres of operations and a responsive extension network had been a comparatively better performance of NR vis-à-vis nine other major crops grown in the country during the period between 1971-72 to 1994-95 (George and Thomas, 1997). However, the complimentary relationship between the growth dynamics of the NR sector and the institutional support mechanisms rooted in a protected price policy regime has been exposed to significant changes in the policy environment consequent to the launching of economic reforms since 1991 (George, 1999a). The growing influence of international price movements compared to the domestic supply-demand gap on the determination of the price in the post-reforms period have been primarily guided by the gradual dilution of tariff barriers on NR imports into the country (Lekshmi *et al.*, 1996; George, 2001). In fact, these policy shifts have also been catalytic to the surfacing of potential agro-management issues which were otherwise subdued under the protected price policy regime. At a macro level, large scale conversion of even agro-climatically marginal lands for NR cultivation with its inherent process of diffusion over time bore the seeds of potential agro-management issues. However, in Kerala, these issues have been accentuated by a growing share of part-time farmers and the resultant higher dependence on hired labour and shortage of skilled labour for tapping (George, 2001; Viswanathan *et al.*, 2002)

In the emerging scenario, there are at least four major agro-management issues deserving policy level attention and appropriate research and development inputs. They are: (i) responses of the planting community to the challenges in the context of price decline and market uncertainty as illustrated by the cost reducing measures through dilution of various prescribed agro-management practices (Viswanathan and Rajasekharan, 2001); (ii) sustainability of area under NR cultivation in the agro-climatically marginal lands; (iii) policy priorities on increasing NR production or maximising net farm income with concomitant questions on the monoculture status of NR cultivation; and (iv) compatibility of the prevailing institutional support mechanisms with the current and emerging issues (George, 2001). In a polemic sense, the issues are whether the widely applauded achievements of the NR production sector under a protected policy regime bore the seeds of current agro-management issues or the current phase is heralding a new restructuring process? Although a consensus on the plausible explanations are rather difficult, observations emerging from a comprehensive study (Joseph *et al.*, 2002) tend to highlight a paradigm and a paradox. Prima facie, the paradigm is centered around the highest reported yield among the major NR producing countries achieved through an input-intensive agro-management regime. Apparently, this high input - high cost - higher yield nexus has been sustained by a protected price policy which ensured remunerative prices in the pre-reforms phase.

The paradox surfacing in the post-reforms phase has been the co-existence of higher yield with higher unit cost of production which is increasingly exposed to external competition and the growing market uncertainties. The relevant inputs to the sustenance of this paradox or paradigm shift in policy initiatives seem to be the major research and development challenge in the emerging context.

Comprehensive research projects

The five major comprehensive research projects undertaken in the area of farm management studies with the basic objective of generating reliable database were (i) adoption of planting materials in the estate sector in two phases; (ii) evaluation of the yield performance of selected rubber planting materials in the context of planting policy; (iii) commercial yield performance of *hevea* clones in India; (iv) trends in the adoption of planting materials in the rubber smallholdings sector; and (v) operational efficiency of rubber plantations under different levels of management. The studies on the adoption of planting materials in the estate sector highlighted the relative popularity of multi-clonal planting and the prominence given to RRII 105 since the 1980s (Joseph and Haridasan, 1991; Chandy *et al.*, 2002). During the 1980s the share of RRII 105 in the total area planted in the estate sector was 39.88 per cent followed by GT1 (14.79 %). In the 1990s, the share of RRII 105 increased to 47.78 per cent followed by mixed planting (17.48 %) and GT1 (7.68 %).

The results of the study on the comparative yield performance of 15 popular planting materials over three time periods in the case of a major planting company located in Kerala indicated better yield performance of PB 28/59, RRIM 605, PB 5/51 and GT 1 during the first ten years of tapping (George *et al.*, 1988b). The comparable nature of observed and estimated yield for the ten year, fifteen year and twenty year periods revealed that a quadratic function of year of tapping alone on yield could provide reliable estimate of variation in yield provided the density is in the studied range across the planting materials. The planting policy of the reporting company was found to be (1970-80) in tune with the yield performance of the selected planting materials during the ten year period.

The results of the comprehensive study on the commercial yield performance of *hevea* clones were based on the yield statements provided by 45 participating estates covering an area of 6999.06 ha since 1974. The evaluation of yield performance of six RRII varieties, five RRIM varieties and twelve varieties of PB origin indicated that RRII 105 recorded the highest mean yield (1703 kg/ha) followed by PB 260 (1607 kg/ha) during the first ten years of tapping (Joseph *et al.*, 1999). Although PB 260 had the advantage of having the lowest extent of immature phase among all the clones covered, its yield prospects had been affected by higher incidence of tapping panel dryness (TPD). Generally, higher yielding clones showed higher instability whereas the yield of RRIM 600 and PB 5/51 were found to be more consistent. The clones PB 235 and RRII 105 showed comparatively wider fluctuations in yield. Among the clones covered, RRII 105 was found to be better suited to Indian conditions from the commercial angle.

The study on the adoption of planting materials in the smallholdings sector in India covered the rubber growing regions in Kerala and Tamil Nadu during the periods 1989-90 and 1994-95. The database was the documented information gathered under the Rubber Plantation Development (RPD)

scheme for 10294 ha during 1989-90 and 7146 ha during 1994-95. The results of the study indicated that there was a revealed preference for RRII 105 (83.31% and 85.75%) across regions and all size-classes during the reference years (Veeraputhran *et al.*, 1998). An inverse relationship was observed between holding size and extent of monoclonal planting. Multi-clonal planting (61 %) was observed only in the largest size class of above 4 ha. Apparently, the smaller size-groups were not inclined to risk the proven yield record of RRII 105.

The two phases of the study on the operational efficiency of rubber plantations at different levels of management have been completed and the draft report conceived in two parts is in the process of final editing. The study was initiated with the basic objective of capturing the major factors determining resource use efficiency across various size-classes within the dominant smallholdings sector. In the first phase, a reconnaissance survey was conducted among 2161 households covering area of 3567 ha in the four selected survey regions, viz., North Kerala, Central Kerala, South Kerala and Nagercoil region in Tamil Nadu (Joseph *et al.*, 2002). The households with an area of less than 0.20 ha were excluded from the survey as a majority of them had been following cultural practices more suited to homestead farms. The mean size of area under possession was 1.65 ha and mean size was the highest in North Kerala (1.82 ha). Average size of area under NR was 1.08 ha and in the adoption of planting materials RRII 105 dominated with a relative share of 57.9 per cent over four decades. Almost 54 per cent of the sample holdings belonged to the second generation of plantations with significant regional variations. Among the crops replaced by NR, coconut was found to be the major victim with a share of 32.1 per cent with regional variations.

In the second phase of the study 644 sample fields with a total area of 513.3 ha were covered across the four regions. The mean duration of immature phase was reported to be 7.1 years and the highest duration was reported in Kanyakumari (7.6 years) among the four regions. The estimated average labour and material costs during the immature phase was Rs.137633/ha. The share of material costs was 50.16 per cent compared to 49.84 per cent share of labour costs. At the disaggregate level, the major components of material costs were chemical fertilizers and organic manure (34.18 %), planting materials (11.35 %) and plant protection chemicals (2.22 %). The composition of labour costs in the immature phase was dominated by soil conservation (8.67 %), application of chemical fertilizers and organic manure (8.02 %), weeding (6.82 %) and land preparation activities (6.36 %). The composition of both material and labour costs are indicative of a high input-intensive cultural practices in the dominant smallholding sector during the study period.

The yield profile of the sample fields indicated that across the three size classes, the highest mean yield was reported in the smallest size class, viz., 0-2 ha (2053 kg/ha) compared to > 2-4 ha (1936 kg/ha) and > 4 ha (1736 kg/ha). Among the clones, RRII 105 recorded the highest mean yield of 2007 kg/ha. The mean yield of all the fields during the life cycle was 1922 kg/ha.

Short-term evaluations and assessments

An assessment of the input subsidy scheme introduced by the Rubber Board since 1986-87 was made in two phases (George, 1992; Chandy *et al.*, 1998). The results of the first phase of the study indicated that among the various subsidised inputs, chemical fertilizers was the most popular among the small rubber growers. The net cost

saving on account of a shift in favour of straight fertilizers during the post-scheme period was Rs. 326 per ha. The additional mandays generated was 34.19 and estimated input subsidy was Rs. 681.87 per ha. The second phase of the study analysed the differences in the cultural practices between member growers attached to the Rubber Producers' Societies (RPS) and non-members. The adoption of major cultural practices was comparable between the two groups during the pre-scheme period. However, during the post scheme period, the member growers exhibited better adoption of cultural practices such as cover crop establishment, soil and leaf analysis, straight fertilizer application, rainguarding and processing of graded sheets. One of the explicit gains of the member growers was a statistically higher annual average yield difference of 151 kg/ha.

Another important evaluation study conducted was the impact of price decline and market uncertainty in the post-1997 period on important agro-management practices (Viswanathan and Rajasekharan, 2001). The agro-management practices considered for evaluation were fertilizer application, spraying, rainguarding, labour use, soil testing, plant protection measures and growers' sales preferences. The study showed that there was a perceptible decline in the adoption of all the cultural practices considered. The extent of decline in the proportion of farmers applying fertilizer was 14.8 per cent while it varied between 25.6 per cent to 47.9 per cent in the case of various plant protection measures.

The case study on the rubber tappers attached to the smallholdings in Kerala focused on the socio-economic profile of the tappers, employment, wages and earnings. The study assumes importance in the context of the structural devolution in the smallholding sector over the past five decades leading to various agro-management issues with serious implications on the labour market. The two major contradictions observed in the labour market are shortage of skilled tappers vis-à-vis non-availability of adequate tapping task for the dependent labour force. An important feature of the labour market is a very low participation by female labour and inadequate presence of younger tappers (Viswanathan *et al.*, 2002). The higher average area of land possessed by the tappers confer them a distinct status in contrast to the predominance of marginal and landless labourers in the general agricultural sector in the state. An important consequence of the structural devolution in the smallholdings sector has been growing multiple grower dependence among tappers with regional variations. At the aggregate level, the extent of dependence was 37 per cent whereas in the traditional rubber growing region of central Kerala the share was 57 per cent. Another important consequence was the declining number of trees available for tapping per tapper with serious implications on employment and earnings. The availability of secondary sources of occupation and income for the tappers has also been reportedly negligible across the regions. The observations emerging from the study highlighted the need for evolving a labour reserve mechanism attached to the Rubber Producers Societies (RPS) which may ensure adequate supply of tappers to the smallholdings as well as adequate task and employment to the tappers.

Primary processing and marketing

Primary processing

The study on the comparative performance of block rubber processing factories in the estate and non-estate sectors was focused on the capacity utilisation,

average unit cost of processing and relative profitability (George and Kumaran, 1990). The results of the study indicated a lower level of capacity utilisation in the industry (34.27 %) with sector-wise differences. Although during the study period (1987-88) the factories in the non-estate sector had the advantages of higher capacity utilisation and lower average unit cost of processing, the strength of the inverse relationship between the capacity utilisation and the average unit cost was found to be statistically insignificant. Results of the study showed the influence of various extraneous factors contributing to the divergence in the behaviour of selected parameters. The analysis of the cost components of processing at the aggregate level showed the highest share of fuel and power (22.59 %) followed by wages and allowances (16.27 %), interest and bank charges (15.36 %) and depreciation (15.36 %) with sector-wise differences. A further decomposition of cost analysis based on ownership-wise classification revealed the better performance of factories in the private sector within the non-estate sector due to higher capacity utilisation and lower administrative expenses. However, sector-wise comparison of the major components of total value of output showed that factories in the estate sector had a higher share of profit (10.28 %) arising from larger share of qualitatively better grades of block rubber in total production and the resultant higher sales realisation.

Primary marketing

The time series analysis of domestic NR price movements from 1968-69 (coinciding with a major change in price policy) to 1994-95 identified two broad phases, viz., the first phase (1968-69 to 1984-85) with wide but less frequent fluctuations and the second phase(1985-86 to 1994-95) with mild but frequent fluctuations (Lekshmi *et al.*,1996). Among the different variables, domestic NR production was found to be the most significant factor influencing the price. The non-quantifiable factors such as policy on NR imports, timing and channel of the imports were found to be important in generating speculative activity in the domestic market. However, since the early 1990s, the international NR price movements have been exerting a greater influence on the domestic price movements compared to the prominence of endogenous variables in the pre-reforms phase.

The major contributions of the co-operative sector in Kerala to the dominant rubber smallholdings were analysed in the broader context of NR economy of India, the government's price policy and salient features of the primary market (George and Chandy, 1996). One of the major deficiencies in the primary market was the dominance of the intermediaries extracting margins on the smallholders' crop. Various policy changes on the price and market intervention since the early 1970s marked the graduation of the co-operative sector from its initial supplementary role in the primary market to a price stabilising institution till the early 1990s. The establishment of Rubber Producers Societies since 1986-87 was also complementary to the marketing operations of the co-operative sector. Another significant contribution of the co-operative sector had been value addition to the smallholders' raw rubber with the implicit effect of increasing the net income.

The pioneering study on the stockholding practices of rubber small growers in Kerala at different levels of price expectations related to the phase of higher domestic NR prices (1996-97) and the phase of lower prices (1999-2000) revealed certain important behavioural pattern with policy

implications (Chandy *et al.*, 2002). It was observed that stockholding practices prevailed among the growers during both the phases. The major contributing factors influencing stockholding of rubber were asset levels, price expectations, liquidity position and growers perception about the market. While the main motive of stockholding of rubber during the first phase was higher price expectations, relative asset level and specific consumption requirements influenced stockholding during the second phase. During the first phase, the stock of rubber held as a proportion of annual production was 26.77 per cent and the share declined to 15.71 per cent during the second phase. Among the size-classes, the lowest size-groups were found to be more responsive to changes in prices. The pattern of sales of rubber by the growers during the study period clearly showed their flexibility in capitalising seasonal rise in prices which is contrary to the general view that smallholders have inherent constraints in stockholding to take advantage of seasonal rise in prices.

The study on the new forms of discrimination of rubber small growers' processed RSS grades in the context of market uncertainty was an earnest attempt to delineate the emerging trends in the primary marketing (Veeraputhran and Chandy, 2002). The notable developments in the primary marketing of RSS grades of rubber consequent to the steep fall in prices since 1997 have been the futility of the market intervention schemes pursued by the institutional agencies to stabilise prices at remunerative levels and the growing prominence of private dealer network exhibiting signals of oligopsony. In the changed scenario, the private dealer network have resorted to two main strategies so as to shift the burden of market uncertainty to the growers and to maintain the marketing margins. The pursued strategies have been internal restructuring of the marketing network to reduce overhead expenses and downgrading the smallholders' RSS grades. In effect, there has been a growing divergence between published prices of respective RSS grades and growers' price realisation which is posing serious questions on the efforts for quality upgradation of RSS grades processed in the smallholding sector.

Rubber products manufacturing industry and foreign trade

Rubber products manufacturing industry

The research programmes initiated in this area were primarily targeted to capture the underlying factors behind the unique evolutionary dynamics of domestic rubber products manufacturing industry vis-a-vis other major NR producing countries, linkages between resource base and rubber based industrialisation at the regional and international levels, impact of economic reforms on the dominant automotive tyre manufacturing industry in India, trends in India's foreign trade of rubber products and implications of WTO Agreement on the NR sector in India.

Historically, the unique evolutionary dynamics of rubber products manufacturing industry in India had been exemplified for its remarkable transformation since the mid 1930s. The domestic consumption of NR grew at an annual average growth rate of 47.5 per cent during 1930-41 and in the process India had surpassed the domestic consumption of two major NR producers, *viz.*, Malaya and Netherlands East Indies, as early as 1934 (Mohanakumar and George, 1999a). The three major factors pivotal to the growth of the nascent industry had been: (i) cheaper NR and labour; (ii) entry of foreign companies as early as 1930s to

capitalise the comparative advantages in the domestic market; and (iii) colonial patronage to the industry in the backdrop of increased industrial requirements during the inter-war years and the second world war period.

The subsequent pattern of growth of the industry and the country's dependence on NR imports since 1947 bore important policy implications on the future priorities. The two important factors which guided the future direction of growth of rubber products industry had been its sectoral and locational concentration. Sectoral concentration which persisted over time has been characterised by the dominance of dry rubber products sub-sector catering to the requirements of the larger industrial base in the country over time (George and Joseph, 1992; George, 1999b). Consequently, the rubber products manufacturing industry has been locationally concentrated in the regions of general industrial growth in the country with limited forward and backward linkage effects on the raw material base concentrated in Kerala. This unique pattern of development of the industry fostered by domestic-driven demand under a protected policy regime with limited linkage effects on the resource base has been facing serious challenges in the context of growing market integration. The analysis on the impact of the economic reforms in the case of the dominant automotive tyre sector indicated limitations in sustaining the domestic demand-driven export growth to reap the advantages of scale-economies (Mohanakumar and George, 2001). In the emerging scenario, a comprehensive strategy to exploit the locational advantage in the manufacturing of rubber products with higher NR content and diversification in the product range has been highlighted at the regional and international levels (George, 1999b; Joseph and George, 2000).

Foreign trade

The time series analysis of India's foreign trade in rubber products undertaken in two phases showed the country's favourable balance of trade since the early 1970s (Mohanakumar *et al.*, 1995; Joseph *et al.*, 2002). The favourable balance of trade has been showing an increasing trend compared to the fluctuating fortunes in the net balance of trade in the 1990s. During the year 2000-01, the balance of trade in rubber products was Rs. 10216.18 million whereas the net balance of trade in rubber and rubber products was only Rs 3636.44 million. Although the exports of rubber products from India is a horizontal extension of its manufacturing base dominated by the dry rubber products, there has been significant changes in the composition of the exports. At the aggregate level, the share of dry rubber products in the total value of exports declined from 95.25 per cent in 1971-72 to 87.01 per cent in 2000-01. At the disaggregate level, the share of the dominant automotive tyres and allied products also declined from 83 per cent in 1971-72 to around 52.27 per cent in 2000-01. In the 1990s, there has been an increase in the geographical diversification in the exports of rubber products from India. The number of export destinations increased from 100 countries in 1990-91 to 165 countries in 2000-01. The share of latex products in the total value of rubber products exports has registered a significant increase from 0.45 per cent in 1971-72 to 11.85 per cent in 2000-01.

The study on the WTO Agreement and its implications on Indian NR sector is a comprehensive assessment made in the larger context of the evolutionary dynamics of GATT and the consequent trade policy measures initiated by the Government of India from 1995-96 to 2001-02 (Joseph and

George, 2002). From a policy angle, the contradictions observed in the fixation of bound rates of dry forms of processed NR were analysed and suggested appropriate policy inputs for modification of the bound rates. The committed bound rate of 25 per cent for dry forms of processed NR can be modified according to the provisions of Article XXVIII of the GATT 1994. Since NR is categorised as an industrial product, the provisions related to subsidies are those covered under the Agreement on Subsidies and Countervailing Measures. As India falls under the Annex VII list of developing countries, its *ad valorem* subsidisation can go up to 3 per cent. However, expenditure of the Rubber Board for research activities and developmental schemes in the backward regions of North-East India, need not be included in the *ad valorem* subsidisation. As the extent of actionable subsidies is 3 per cent, the domestic support measures for NR in India can be expanded without infringing the provisions of the WTO Agreement. Hence, it was proposed to expand the domestic support measures by increasing the subsidies for new planting and replanting as well as input subsidy scheme for enhancing productivity.

Intercrops and by-products

Region-wise adoption of intercropping among the rubber smallholdings in the immature phase of rubber plantations in the traditional regions showed a higher share of adoption in Nagercoil region (84 %) followed by South and Central regions of Kerala (70 %) (Joseph *et al.*, 2002). Availability of family labour and perception about profitability are reported to be the major factors influencing the intercropping in all the regions (Rajasekharan and Veeraputhran,2002). Region-wise adoption of intercrops exhibited a strong preference for banana (61%) in the Southern region, pineapple (45%) in the Central region and tapioca (58%) in the Northern region of Kerala. An earlier study on the relative profitability of pineapple intercropping in the immature phase of rubber plantations in Kottayam district estimated a discounted net income of Rs.22443.48/ha for the first three years of rubber planting (Rajasekharan, 1989). Despite the regional variations in the adoption of intercrops and comparative profitability, agronomic suitability also assumes importance in the process of selection. The desirable agronomic practice is simultaneous establishment of both intercrops and cover crops. Such a practice has been found to be operationally feasible only in the case of 'nendran' banana due to the agronomic advantages of less soil disturbance, prevention of weed growth and relatively large availability of crop residues which is a good source of mulching material for rubber (George *et al.*, 2000).

The research projects completed on by-products of rubber plantations were mainly focused on rubber wood and its utilisation. The projects included an assessment of the commercial potential of rubber wood processing industry in India (George and Joseph, 1993), an analysis of the issues at the primary processing of rubber wood (Joseph and George, 1996), operational level issues confronting the processing, utilisation and marketing of rubber wood and the finished products and timber yield potential of selected clones (Viswanathan *et al.*, 1998; Joseph *et al.*, 1998; George and Joseph, 2002; Viswanathan *et al.*, 2002). The extent of commercial exploitation of rubber wood for manufacturing value added products is still at its infancy in India as revealed by the composition and pattern of rubber wood consumption. Even during 2000-01, the share of value added products sector constituted

only 10 per cent compared to the share of packing cases (62%). The major operational level issues affecting the rubber wood sector in India are: (i) predominance of intermediaries in the primary market and the resultant higher raw material cost; (ii) absence of vertical integration and lower scales of operation; (iii) lower levels of capacity utilisation and value addition; (iv) shrinking supply of quality raw material; (v) working capital shortage; (vi) absence of a statutory agency to monitor the prescribed quality standards; and (vii) market access issues. The analysis of the timber yield potential of *Hevea* clones grown in India estimated the timber yield for RRII 200 series (193 m^3/ha), RRIM 600 (167 m^3/ha) and irradiated clones (112 m^3/ha). The results of the analysis highlighted the need for a multi-disciplinary study on the region and clone-specific latex-timber potential of the popular as well as the pipeline clones.

The observations based on the monitoring of beekeeping in rubber plantations revealed certain specific issues affecting the commercial exploitation of this by-product. Apart from the seasonality of honey production in rubber plantations (February to April) there are significant regional differences in the involvement of the farming community in beekeeping. While migratory bee keepers from Kanyakumari district of Tamil Nadu dominate the beekeeping in South and Central Kerala, higher levels of growers' participation was evident in North Kerala (Veeraputhran *et al.*, 2000). Among the regions, beekeeping in rubber plantations was found to be more feasible in North Kerala due to: (i) higher availability of pollen from multiple-cropping pattern in the region; (ii) higher involvement of family labour; and (iii) larger average size of the holdings. The reported mean yield of the dominant indigenous variety of honey bee *(Apis cerana indica)* is 12 kg per hive compared to 39 kg per hive for the exotic variety *(Apis mellifera)*. The processing of raw honey is mainly dependent on the conventional method of heating over a water bath at smaller scale of operations without adopting the technological capabilities developed by relevant R&D institutions in the country. The estimated production of honey during 2000-01 was 4500 tonnes. The pattern of primary marketing of honey is characterised by the dominance of raw honey sales (60%). The average farm gate price of raw honey is Rs 60/kg and Rs 108/kg for processed honey. In recent years, increasing imports of cheaper honey have been posing serious challenges to the domestic honey sector.

The two commercial products processed from dried rubber seed kernel are rubber seed cake and seed oil (Veeraputhran and Joseph, 2000). The estimated production of rubber seed cake which is mainly utilised as a source of cattle and poultry feed is 2600 tonnes in 2000-01. During the year the estimated production of rubber seed oil was 1600 tonnes. In spite of the potential industrial uses, the consumption of rubber seed oil is confined only in the manufacturing of low quality washing soaps mainly due to availability competing sources of oil and lack of awareness.

INTER-DIVISIONAL COLLABORATIVE PROJECTS

Among the three inter-divisional collaborative programmes completed, two were related to the agronomic aspects of NR cultivation and the remaining one was a comparative evaluation of ISNR 20 vis-à-vis conventional forms of NR. The preliminary assessment on the commercial potential of latex sludge indicated that during the mid 1990s around 400 tonnes of the material can

be processed per annum at 70 per cent capacity utilisation of the industry. The potential annual savings by using latex sludge as fertiliser was estimated to be Rs2.20 million (George *et al.*, 1994). The comparative analysis on the immature phase of polybagged plant and budded stump planted fields of *Hevea* under the smallholding conditions showed a statistically significant shorter duration of immature phase for polybagged plant fields (6.99 years). However, the observed advantage of 73 days for the polybagged plant fields was found to be economically insignificant in terms of the discounted annual streams of potential income. The analysis highlighted that apart from shorter immature phase, the cumulative impact of lower vacancy, uniform establishment, higher yield and higher tappability are critical in justifying the adoption of polybagged plants (Joseph *et al.*, 2001). The analysis on the comparative performance of ISNR 20 vis-à-vis conventional forms of processed NR showed better raw rubber properties in the case of sheet grades than ISNR 20 and EBC IX except volatile matter and initial wallace plasticity (Thomas *et al.*, 1995). The sheet grades also had comparable level of consistency in these properties with that of ISNR 20. The vulcanizate properties including ageing characteristics have also been found to be better for sheet grades.

CONCLUSION

In conclusion, it is also important to highlight the relative contributions of the Economics Division since its formal establishment as a constituent part of the RRII. In retrospect, an objective assessment of the contributions calls for an evaluation based on the perceived research mandate. At the aggregate level, the three broad areas of research concerns have been: (i) analysing contextually specific issues in the NR sector and allied areas so as to generate a comprehensive database and relevant policy inputs; (ii) providing relevant conceptual basis for interdisciplinary research in the RRII based on the results of the research programmes undertaken in the Division and; (iii) comprehending the global developments in the rubber sector and conceptualising the same in the regional and international contexts for meaningful policy initiatives. In this conceptual backdrop, a summary of the major achievements of the Division during the past one decade are listed in the following order:

i. Building up a comprehensive database and analytical inputs on yield performance of major planting materials, rubber products manufacturing industry, foreign trade in rubber and rubber products, rubber wood and honey from a policy perspective.
ii. Comprehensive studies on the dominant smallholding sector such as resource use efficiency, intercropping practices, impact of input subsidy scheme, labour management and primary marketing with relevant policy inputs.
iii. Pioneering in-house study on the operational efficiency of rubber plantations at different levels of management.
iv. First crop-specific study on the implications of WTO Agreement with relevant policy inputs to the concerned authorities.

In the emerging context, the major research priority of the Division will be interdisciplinary research programmes so as to address the challenges encountering the NR sector and to provide relevant policy inputs from a long term perspective .The major components of the proposed research programmes shall be detailed expositions of factors hampering competitiveness at the

levels of farm management, primary processing and marketing, product manufacturing and external trade. In the ongoing process of market integration, such a holistic view of the interdisciplinary priorities is construed to be the basis for policy initiatives compatible with the revealed challenges and responses.

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