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Expansion of Natural Rubber Cultivation in Kerala: An Exploratory Analysis

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I

INTRODUCTION

The underlying theoretical perceptions which codified the price stabilisation schemes for the perennial plantation crops in the post-colonial era had been the positive relationship between comparative stability in prices and growth in production/area across the crops. However, the experience of International Commodity Agreements (ICAs) during the past five decades revealed notable deviations from the perceived relationship in the case of plantation crops. The major contributing factors behind the observed deviations include: changes in relative profitability, market structure, market orientation, extent of value addition in the producing countries, competing alternatives in the conducive agro-climatic base and an array of institutional factors.[1] Although relative profitability is a critical policy input in the farm management decisions for the annual as well as perennial crops, the long run price stability assumes added significance in the case of perennial crops for three important reasons, viz., (1) higher initial investment, (2) higher gestation period and (3) longer economic life. The contention on the relative importance of price stability vis-a-vis profitability is borne out of the fact that the over-riding objective of the post-colonial ICAs on perennial plantation crops had been price stabilisation based on market signals at mutually acceptable levels (George, 1987; Corea, 1992; George and Sethuraj, 1996). The implicit detachment from policy inputs ensuring the profit margins had been a salient feature of the post-colonial ICAs vis-a-vis the ICAs that emerged during the inter-war years.[2] Despite varied experiences of perennial crops across countries and the policy initiatives to achieve comparative stability of prices, all the post-colonial ICAs have collapsed with remote chances for revival.[3] The two common factors contributing to the collapse of all the post-colonial ICAs on perennial crops appear to be: (1) the basis of price stabilisation schemes which revolved around market signals without providing due allowance for steady increases in the cost of inputs and (2) negligible progress in the value addition by the producing countries. The resultant erosion in the profit margins across the crops exposed the

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futility of ICAs as a reliable mechanism for ensuring remunerative and stable prices for sustainable production from the angle of the producers.

The crisis entangling the perennial crops has been relatively more severe in the plantation crops sector concentrated in developing countries due to a variety of structurally rooted factors with the characteristic focus on export-oriented production. The plight of the world natural rubber (NR) economy in the post-colonial phase is an illustrative case exhibiting the main features of the protracted crisis in terms of growing instability and decline in free market prices, steady erosion of profit margins and absence of any meaningful mechanism to stabilise prices at remunerative levels.[4] Though the responses of the major NR producing countries to the crisis in terms of trends in area under the crop varied,[5] the unique case of a steady expansion of area under NR cultivation in the state of Kerala, which accounts for about 85 per cent of total area under NR cultivation in India, deserves attention.

In this context, it is important to note that so far no serious attempt has been made to study the relationship between comparative profitability and trends in the area under major crops in the state over time. To a large extent, this vacuum in the analysis can be explained in terms of non-availability of reliable and comparable time-series data on relative profitability across the major crops. Systematic attempts to explore the relationship between comparative stability of prices and trends in the area under major crops in the state are also non-existent. The overwhelming volume of literature on comparative price stability is focused on its impact on production and yield across individual crops (Hazell, 1984; Devi, 1977; Ipe and Prabhakaran, 1988; Mitra, 1989; Smith and Lapp, 1993; Naylor *et al.*, 1997). However, the choice of production as a proxy for area is more justified in the case of annual crops for the relative flexibility in responding to changes in prices.

In the Indian context, the impact of commodity price stabilisation on area under annual crops was studied by taking six crops, viz., rice, wheat, cotton, jute, groundnut and sugarcane (Narain, 1965). The study revealed that the farmers were significantly responsive to price with notable preference for high value cash crops. The observed pattern of crop shift in Kerala favouring perennial crops was explained in terms of agro-climatic factors and product wage vis-à-vis labour productivity (Kannan and Pushpangadan, 1988). However, the unique case of NR, which had been enjoying a protected price policy regime since 1942 and the apparent comparative stability of prices, has never been considered as an explanatory variable to analyse the observed pattern of crop shift favouring the crop.[6]

II

STATEMENT OF THE PROBLEM

Kerala's agriculture sector has undergone significant structural transformation since the early 1970s in favour of relatively less labour intensive perennial crops often at the expense of annual crops. The gradual transformation in the cropping

pattern of the state's agriculture culminating in the dominance of perennial crops, especially plantation crops, is evident from the fact that by 1998-99 this segment accounted for more than 63 per cent of the total cropped area (Government of Kerala, 2000). Kerala is India's premier plantation state accounting for 46 per cent of the total area under the plantation crops and 40 per cent of its production (George and Mohanakumar, 1997). The changes in the cropping pattern favouring perennial crops which are basically dependent on the external markets (within and outside the country) have serious implications at the operational and policy levels as many of these commodities are subject to wide price fluctuations which are not conducive to planning and investment for sustainable production. Kerala holds a near monopoly position in cultivation (85 per cent) and production (93 per cent) of NR in India and the state has been maintaining this unique position since the introduction of NR cultivation in the country (Rubber Board, 2000). An important feature of the NR economy of Kerala is the dominance of small holdings sector with a share of 91 per cent in the area under cultivation. NR also plays a vital role in the agrarian economy of the state as the share of the crop in the total cropped area is 15.67 per cent, contributing 15.16 per cent of the state agricultural gross domestic product (GDP), providing direct employment to more than 3.4 lakh persons (Government of Kerala, 1999; Rubber Board, 2000).

In Kerala, during 1998-99 seven important crops, viz., paddy, tapioca, coconut, rubber, coffee, tea and cardamom occupied more than 67 per cent of the area under cultivation (Government of Kerala, 2000). Among all the crops, the maximum increase in the relative share of area has been registered by NR (9.35 per cent) during the period between 1970-71 and 1998-99 and the area under NR has increased to the extent of more than 149 per cent during the same period. The general perceptions in the academic and policy circles on the dynamic growth of NR cultivation in Kerala have been centred around the relative price stability and profitability vis-à-vis other crops and a better institutional support from the stage of cultivation to marketing. Therefore, this paper is basically conceived to capture the relative contributions of the major factors identified in explaining the dynamic growth of area under NR in the state. Apart from the comparative stability of prices, the analysis is primarily focused on the roles of relative profitability, institutional support and technology shift in the production process. The paper assumes relevance in the context of post-GATT (1994) economic reforms initiated in the country as the extent of difference in protective policy inputs across the crops has been steadily narrowing down in recent years. This growing trend in synchronisation of world and domestic prices and harmonisation of the policy initiatives pose serious questions on the pattern and composition of Kerala's agriculture sector with its characteristic dominance by the perennial crops.

III

ANALYTICAL FRAMEWORK

The paper is organised into two parts. The first part deals with the analysis of relative contributions of the four selected factors, viz., comparative price stability, relative profitability, institutional support mechanisms and technology shift, in explaining the expansion of area under NR in the state. The second part is focused on the different phases and sector-specific sources of growth followed by conclusions. The analysis was proceeded with the assumption that comparative stability could be the major explanatory variable for the observed trend in area expansion under NR in the state. The comparative stability of prices of selected crops was analysed by using instability index (Appendix 1). In the absence of comparable time-series data on cost of production and relative profitability, the implicit factors and indicators underlining the comparative advantages and the performance of NR were analysed so as to provide meaningful insights into the observed pattern of growth. The role of institutional support mechanism at different levels of operations was analysed during the period under review. The relative contributions of technology shift leading to growth in yield were also analysed from a comparative perspective in order to capture its role in propping up the relative profitability and the resultant expansion of area under the crop.

The analysis on the selected explanatory variables was followed by an attempt to identify the distinct phases of growth in area, if any, under the crop. Dummy variable test and Kinked exponential function were used to identify the phases and rate of growth in area in the respective phases (Appendix 2). This part of the analysis was also extended to the disaggregate level, viz., the estates and small holdings, so as to examine the sector-specific sources of growth.

The study was based on secondary data. The relevant data on six selected crops in Kerala, viz., paddy, coconut, tapioca, tea, rubber and cardamom from 1968-69 to 1995-96 issued by the Bureau of Economics and Statistics, Government of Kerala and Rubber Board have been used for the analysis. Among the major plantation crops, coffee is omitted due to non-availability of time-series data related to the selected variables during the reference period. The relative share of the six selected crops together in the total cropped area of the state was 65 per cent during the year 1998-99. The year 1968-69 marks the beginning of a major policy shift characterised by price decontrol and market interventions by the Government in the case of NR. The selection of the year 1968-69 is also justified in terms of the marginal changes in the total cropped area of the state from 1968-69 to 1995-96 (0.55 per cent) compared to a higher growth rate during the period between 1960-61 and 1968-69 (2.4 per cent). The terminal point of the reference period was selected based on the availability of data related to all variables of the selected crops.

IV

COMPARATIVE PRICE STABILITY

The NR price during the study period was expected to be relatively more stable as none of the other five crops selected had the benefit of frequent government interventions in different forms to stabilise the prices at remunerative levels (Lekshmi *et al.*, 1996; George and Thomas, 1997; George and Chandy, 1996). However, as evident from Table 1, though the area under NR has recorded the highest growth rate

TABLE 1. INSTABILITY INDEX OF PRICE AND GROWTH RATES OF AREA

	1968-69 to 1995-96		
Crop	CV	Instability index	Growth rate of area
(1)	(2)	(3)	(4)
Paddy	0.512	19.82	-2.45*
Coconut	0.639	18.09	0.98*
Tapioca	0.806	16.13	-3.92*
Tea	0.621	15.21	-0.42*
Rubber	0.675	17.87	3.62*
Cardamom	0.626	33.74	-0.15

Sources: (1) Government of Kerala, *Statistics for Planning*, Thiruvananthapuram (relevant issues); and (2) Rubber Board, *Indian Rubber Statistics*, Kottayam (relevant issues).

Growth rate calculated using the formula ln Y = a + bt.

* Significant at 5 per cent level.

among the six crops, it occupies only the third position in terms of price stability. The observed results are in sharp contrast to the theoretically perceived linear relationship between comparative price stability and area under the perennial crops. Although the prices of tea and tapioca have shown the lowest instability indices, the area under both the crops have significantly declined. Among the six crops, positive growth rates in area had been registered only under NR and coconut. As the observed results are inadequate to provide explanation for the growth in area under NR, it becomes necessary to focus the analysis on the other major indicators of performance vis-à-vis growth in area among the selected crops. Table 2 shows the rates of growth in area, production, yield and price of the selected crops.

TABLE 2. GROWTH RATES OF MAJOR INDICATORS OF SELECTED CROPS IN KERALA - 1968-69 TO 1995-96

Crop	Price	Yield	Area	Production
(1)	(2)	(3)	(4)	(5)
Paddy	5.72*	1.31*	-2.45*	-1.14*
Coconut	8.55*	0.10	0.98*	1.08*
Tapioca	9.63*	0.88*	-3.92*	-3.04*
Tea	8.19*	2.05*	-0.42*	1.68*
Rubber	7.89*	2.82*	3.62*	6.37*
Cardamom	7.19*	5.23*	-0.15	2.52*

Sources: Same as in Table 1.

Growth rate calculated using the formula ln Y = a + bt.

* Significant at 5 per cent level.

Despite the disparate trends observed in the selected variables of the six crops, Table 2 is illustrative of the unique status of NR exhibiting positive growth rates in all the selected indicators of performance. In the case of NR, a discernible trend is observed in the relative rates of growth in area, yield and production. Apparently, the higher rate of growth in area might have contributed to the highest rate of growth in the production of NR, followed by coconut compared to the relevance of rate of growth in yield in the case of tea and cardamom in explaining the significant growth rates in production. To a large extent, the plausibility of this contention is validated by the reported differences in yield of NR across the various agro-climatic regions within the state indicating the area expansion under the crop surpassing the prescribed agro-climatic conditions (George and Mohanakumar, 1997). Conversely, the area under tea has shown a negative growth rate in spite of its highest price stability and relatively higher rate of growth in prices during the period. A positive rate of growth in production of tea has been sustained by a higher rate of growth in yield indicating replacement of marginal and unviable holdings to alternative crops, especially NR, since the 1970s (Tea Board, 1979). The growth patterns observed in the case of other major crops in the state were not unique and were reported to have been guided by factors underlying relative profitability in the region-specific contexts, technological gaps in appropriate crop mix, relative labour intensity, institutional support and infrastructural facilities, market orientation and value addition (Kannan and Pushpangadan, 1990; Kannan, 1999; Mohanakumar and George, 2001).

V

RELATIVE PROFITABILITY

In the absence of comparable time-series data on the relative profitability of NR and other selected crops, implicit indicators of profitability, viz., comparative growth rate of total revenue per unit area, salvage value of rubber trees and the reported crop shifts in favour of NR, are analysed to explain the farmer's revealed preferences for the crop. Table 3 shows the growth rates in total revenue of NR vis-à-vis other crops during the period under review.

TABLE 3. GROWTH RATES IN TOTAL REVENUE PER UNIT AREA† - 1968-69 TO 1995-96

Crop (1)	Growth rate (2)
Paddy	4.62*
Coconut	6.71*
Tapioca	3.91*
Tea	10.19*
Rubber	10.93*
Cardamom	12.43*

Sources: Same as in Table 1. † Product of yield and price.
Growth rate calculated using the formula ln Y = a + bt.
* Significant at 5 per cent level.

Table 3 shows that among the six crops, cardamom has the highest rate of growth in total revenue, followed by NR and tea. In an agronomic sense, crop shifts among these three plantation crops are rather limited although the reported conversion of small and uneconomic tea gardens to NR cultivation in Kottayam and Idukki districts of the state in the 1970s deserves mention. However, from the angle of relative agro-climatic suitability and profitability, the crop shifts in favour of NR from coconut and tapioca were more relevant in the Kerala context. This observation is corroborated not only by the wider gap in the rate of growth of total revenue of NR compared to coconut and tapioca (Table 3) but also by the reported crop shifts in favour of NR in the southern districts of Kottayam, Alleppey and Quilon, which were mainly on account of widespread root-wilt disease affecting the profitability of coconut cultivation since the late 1970s (Narayana *et al.*, 1991).

An important factor supplementing the relative profitability of NR vis-à-vis other crops since the late 1970s has been the growing commercial importance of rubber wood for a variety of industrial applications (Joseph and George, 1996). Though the extent of commercial exploitation of rubber wood in the state for the manufacture of value added products such as furniture, panel products and medium density fiber board (MDF) is not comparable to the achievements of major NR producing countries like Malaysia, its evolution from the status of a source of firewood to an alternative source of industrial timber is commendable. The net impact of this transformation has been a steady increase in the salvage value of rubber plantations leading to a higher profitability of NR cultivation. The current estimated value is in the range of Rs. 75,000 to Rs. 1,50,000 per hectare (ha) depending on a variety of factors such as the number of trees/ha and girth of the tree, etc. (RRII, 2000). A higher salvage value and its realisation at the same point of time are unique to NR compared to other selected crops in the state.

VI

INSTITUTIONAL SUPPORT

The role of a well conceived and comprehensive institutional support mechanism to NR realising its strategic commercial importance in the Indian economy, is relatively well documented (George *et al.*, 1988; George and Thomas, 1997; George and Chandy, 1996; George, 1999). In an operational sense, the institutional support extended to NR has been unique which encompassed all stages of operations from cultivation to marketing. The statutory price regulation of NR prices initiated since 1942 was a major milestone in the evolutionary growth of area under the crop in the state. The subsequent market interventions by different government agencies under the Central and State Governments were primarily guided by the motive of ensuring remunerative prices to the growers so as to achieve self sufficiency in NR production (George, 1999). The different forms of market intervention schemes followed in various historical contexts have been actively supported by efforts to modernise the technology of cultivation, production and processing under the institutional frame-

work created with the establishment of the Rubber Board in 1947 and the Rubber Research Institute of India (RRII) in 1955. Although the relative achievements of the different policy components varied, the support mechanisms extended by the Government of India and the State Government were relatively complimentary and ensured a steady growth in area under the crop. For instance, the growth of the co-operative rubber marketing societies in the state since the 1960s has played a critical role in the NR market intervention schemes initiated by the Government of India in different contexts ensuring effective procurement operations and also has been effective in reducing the intermediaries' margins (George and Chandy, 1996). Similarly, while the planting and input subsidy schemes initiated by the Government of India since 1957 have been effective in promoting the expansion of area under NR and its scientific cultivation by subsidising the development cost during the immature phase[7], the land reform measures initiated by the State Government since 1957 had resulted in a significant sectoral crop shift favouring rubber small holdings (for a detailed discussion see the section on phases of growth).

Having explored the comparative performance of the selected quantifiable explanatory variables, it would be appropriate to juxtapose the status of major institutional support mechanisms for the selected crops from 1968-69 to 1990-91 (Table 4).[8]

TABLE 4. STATUS OF SELECTED INDICATORS OF INSTITUTIONAL SUPPORT- 1968-69 TO 1990-91

Crop/ Indicators	R&D support	Planting subsidy	Extension network	Market support	Farm gate price as per cent of terminal price
(1)	(2)	(3)	(4)	(5)	(6)
Paddy	Available	Not available	Weak	Ineffective	Low
Coconut	Available	Available	Weak	Ineffective	Low
Tapioca	Available	Not available	Weak	Nil	Low
Tea	Available	Available	Effective	Nil	Low
Rubber	Available	Available	Effective	Effective	Highest
Cardamom	Available	Available	Effective	Nil	Unstable

Source: Personal communication from the concerned Commodity Boards and R&D institutions.

Table 4 indicates that NR was the only crop to which support mechanisms at the farm level had been actively supplemented by a protected price policy regime leading to higher farm gate prices expressed as a percentage of the final consumer price (Sreekumar *et al.*, 1990; George and Chandy, 1996). The cumulative impact of a comprehensive and unique policy package for NR appears to be the centripetal force sustaining the economic viability and propelling a steady expansion of area under the crop.

VII

TECHNOLOGY SHIFT

The potential role of the development of high-yielding varieties (HYVs) of planting materials with its package of practices and the extent of adoption of the same in sustaining the viability of modern agriculture is widely recognised. In the case of NR cultivation in the state, the development of the HYV planting material RRII 105 in the 1970s and its official release by the Rubber Board in 1980 for unrestricted planting and a comparatively higher adoption of the new variety by the dominant small holding sector,[9] have significantly transformed the viability of rubber cultivation. A relatively higher realised and potential level of yield of the clone across the various agro-climatic zones within the state and incentives for the adoption of the clone contained in the integrated rubber plantation development scheme since 1980 resulted in a vertical shift in the yield profile of the crop. Table 5 compares the growth rates of yield of NR in the state between 1960-61 and 1985-86 and from 1986-87 to 1995-96.

TABLE 5. SHIFT IN YIELD OF NATURAL RUBBER IN KERALA

Period (1)	Growth rate of yield (2)
1960-1985	3.81*
1986-1995	5.31*

Note: The choice of the terminal period is guided by the fact that the crop has a minimum gestation period of six years for commercial production.

* Significant at 5 per cent level.

The relative popularity of the clone among small holdings is reported to be very high as more than 85 per cent of the area replanted and new planted with planting subsidy since the mid-1980s had been with the RRII 105 (Veeraputhran *et al.*, 1998). The observed trends in the NR sector in the state underlines the complementary relationship between an appropriate institutional framework and a highly receptive farming community in realising the potential benefits of research and development efforts.

VIII

PHASES OF GROWTH

Despite the probable questions on the technical virtuosity of the explanations offered on the growth of area under NR in Kerala vis-à-vis other major crops, the unique case of the crop warrants further investigation so as to demarcate different phases of growth and to identify the phase-specific contributing factors, if any. The documented time-series data on area under NR in the state are available from 1955-56. However, sectorwise information on area, i.e., area under estates and small

holdings, are available only from 1960-61. Therefore, the analysis is based on trends in the area under NR since 1960-61 so as to capture sectorwise sources of growth.

During the period 1960-61 to 1995-96, the area under rubber grew at a rate of 3.38 per cent compared to the growth rate of total cropped area of 0.55 per cent in the state. Functional forms such as linear, semi-log, Compertz and logistic curve can identify different phases of growth statistically. The usual method for the estimation of periodwise growth rate is to estimate separate regression for each period. Periodwise growth rate is more reliable (Boyce, 1986) if it can be estimated through a Kinked exponential function, which imposes a continuity restriction at the breakpoints between sub-periods. A dummy variable '0' for the period upto 1975-76 and '1' from 1976-77 to estimate the presence of a break, if any, in the trend growth rate, was used. The results obtained using dummy variables are as follows:

ln Y =	5.85 + 0.0785 t + 0.0118 Dt		R^2	DW
t-values	(20.41)	(2.3)	0.97	1.31

TABLE 6. PHASEWISE GROWTH RATE OF AREA UNDER RUBBER

Period	Growth rate (per cent)	t-value
(1)	(2)	(3)
1960-61 to 1975-76	2.33	12.21
1976-77 to 1995-96	4.08	29.96
R^2	0.961	
DW	1.21	

Source: Rubber Board, *Indian Rubber Statistics*, Kottayam (relevant issues).
Growth rate is calculated using Kinked exponential function: $\ln Y = a_1 + b_1 (D_1 t + D_2 t) + b_2 (D_2 t - D_2 k) + u_t$.

At the point 1975-76, a significant coefficient was obtained for 'D_t' which confirmed the presence of a break at that point. The analysis showed that there were two statistically identifiable phases of growth, viz., 1960-61 to 1975-76 and 1976-77 to 1995-96. The growth rates obtained were significant and in the first phase, the area under rubber grew at a rate of 2.33 per cent compared to 4.08 per cent in the second phase (Table 6). In this context, it is pertinent to examine the sectorwise performance in the two phases in order to identify the major contributing factors.

Table 7 reveals that in both phases the rate of growth in area under small holdings was higher but the second phase was marked by highest rate of growth. Conversely, the trends in the estate sector showed marginal increase in the first phase and a negative rate of growth in the second phase indicating a decline in total area. During the period under review (1960-61 to 1995-96) the area under the small holdings grew at a rate of 4.39 per cent whereas the area under the estate sector declined at a rate 0.62 per cent. Therefore, the observed trends underline the point that the major sources of growth in area under NR in the state had been basically the factors contributing to the growth in area under the small holdings sector. However, due to

paucity of quantifiable data on the contributing factors, the analysis is focused on the proximate reasons and policy initiatives propelling the growth in area under the small holdings sector.

TABLE 7. GROWTH RATES OF AREA UNDER THE SMALL HOLDINGS AND ESTATES

Year (1)	Small holdings (2)	Estates (3)
1960-61 to 1975-76	3.45*	0.44*
1976-77 to 1995-96	5.21*	-0.91*
1960-61 to 1995-96	4.39*	-0.62*

Source: Rubber Board, *Indian Rubber Statistics*, Kottayam (relevant issues).
* Significant at 5 per cent level.

The incremental change in the area under small holdings since 1960-61 had been declining till 1965 except during 1961-62. The peak level of growth in the area achieved during the early 1960s of the first phase merits attention as there were important policy initiatives contributing to the growth in the area under the sector since the mid-1950s as reported in an earlier study.[10] The three identified policy initiatives which would have significantly contributed to the increase in area under small holdings were: (1) the Plantation Labour Act (1951), (2) the Replanting Subsidy Scheme (1957) and (3) the Land Reform Measures initiated in the state since the late 1950s. The exemptions given under the land ceiling provisions of the Plantation Labour Act and land reforms measures were reported to have contributed to sectoral and crop shifts in favour of NR under small holdings during the late 1950s.[11] Moreover, the administrative compulsions arising from the need for unregistered holdings to register with the Rubber Board for availing planting subsidy under the Replanting Subsidy Scheme (RSS) of 1957 had resulted in an increase in the officially documented data on area under small holdings (George *et al.*, 1988).[12] Though there was an increase in the rate of incremental change since 1965-66, the remaining period in the first phase was not characterised by any comparable ups and downs. However, the growth momentum gathered since the late 1950s could not be sustained during the period from 1961-62 to 1965-66 as evident from the decline in the incremental change. It would be logical to argue that while the sectoral shift in favour of the small holdings was more pronounced during the late 1950s resulting in a higher incremental change till 1961-62, the incentives to induce crop shift in favour of NR from small holdings cultivating other crops would not have been adequately explicit.

The second phase was characterised by an unprecedented increase in the area under small holdings beginning from 1977-78 and lasting till 1984-85. The area under small holdings grew at a rate of 7.48 per cent (during the period 1977-78 to 1984-85), surpassing the average growth rate of 5.21 per cent recorded in the second phase. The two important developments which might have substantially contributed

to the observed rate of growth were: (1) the launching of a comprehensive credit linked New Planting Subsidy Scheme (NPS) in 1979 and (2) the release of the HYV clone RRII 105 in 1980. This period also coincides with the active market intervention by the State Trading Corporation of India (STC) to export surplus stocks so as to restore the NR price at remunerative levels (George *et al.*, 1988). The progressive nature of the NPS favouring the small holdings and its subsequent merger with RSS had a salutary effect on the growth in area under NR during the Sixth Plan period (1980-81 to 1984-85).[13] During this period, the performance of new planting exceeded the target by 77 per cent (George and Thomas, 1997). The two supplementary factors which acted in tandem with the major policy initiatives in promoting the growth in area under small holdings were: (1) the prevailing law of inheritance in the state of Kerala and (2) the differential slab rates and exemptions given to this sector under the Agricultural Income Tax Rules in the state. The observed deceleration in the rate of growth in area (3.2 per cent) under the sector since 1985-86 appear to have been contributed by the growing limitations imposed by the availability of agro-climatically suitable land for further expansion and the gradual decline in the relative share of planting subsidy in the steadily increasing development cost.[14]

In contrast to the trends observed in the small holding sector, the rate of growth in area under the estate sector was marginal in the first phase and negative in the second phase. Historically, the dominance of the estate sector in NR cultivation in the state had revolved around the large public limited companies promoted by the British. However, by the late 1950s the expansion of area under different forms of ownership in the estate sector appeared to have reached a plateau arising mainly from the non-availability of agro-climatically suitable large tracts of land and legal restrictions on the expansion of cultivation to the forest lands.[15] A notable exception to the decline in the rate of growth under the estate sector was the large-scale entry of public sector corporations in NR cultivation in the state since the early 1960s mainly by conversion of reserve forests. Operationally, the absolute decline in area under the public limited companies was more than compensated by the increase in area under the public sector corporations (George *et al.*, 1988). This trend is reflected in the positive rate of growth of area under the estate sector (0.44 per cent) in the first phase. More than 74 per cent of the total planted area during the period under review by the three major public sector corporations, viz., Plantation Corporation of Kerala (PCK), Rehabilitation Plantation Limited (RPL) and State Farming Corporation (SFC), was during the first phase. Table 8 illustrates the point.

TABLE 8. AREA UNDER NATURAL RUBBER: ENTRY OF PUBLIC SECTOR UNDERTAKINGS

(ha)

Period (1)	PCK (2)	RPL (3)	SFC (4)	Total (5)
1960-61 to 1975-76	5,645	1,443	-	7,088(74.05)
1976-77 to 1995-96	621	651	1,212	2,484(25.95)
Total	6,266 (65.46)	2,094 (21.88)	1,212 (12.66)	9,572 (100.00)

Source: Primary records of the companies.
Figures in parentheses indicate percentages to the total.

Despite the steady increase in area under the public sector corporations since the early 1960s, the area in the estate sector recorded a negative rate of growth (-0.91 per cent) during the second phase. In this context, the observations made in an earlier study assume importance (George, 1999). It is pointed out that during the period between 1960-61 to 1994-95 while the relative share of the public sector corporations in the total area under the estate sector increased by more than 27 per cent, the relative share of the corporate group and proprietary concerns declined by 6 and 23 percentage points respectively. Therefore, the expansion of area under the public sector corporations had been inadequate to sustain the rate of growth in the estate sector during the second phase. The sub-division and fragmentation of the area under the relatively smaller estates owned by the proprietary concerns might have been guided by the potential benefits enveloped in the ceiling legislations as well as the direct impact of the law of inheritance in the state.

IX

CONCLUSIONS

In spite of the phasewise differences in the policy initiatives catalytic to the growth, the observations emerging from the study tend to highlight the point that the expansion of area under NR in the state had been primarily guided by the relative profitability ensured under a comprehensive institutional support mechanism in which protected price policy had been the critical component. However, since the late 1980s, the tempo of growth has been circumscribed by the agro-climatic limits and policy changes in the protected price policy regime since 1991-92. Therefore, not only the scope for further expansion of area under NR in the agro-climatically marginal lands in the state is limited but also the sustainability of the crop in such lands under the small holdings is poised to region-specific crop shifts. As sustainability of NR production in the state is heavily dependent on the viability of the dominant small holding sector, a paradigm shift in the policy initiatives is necessary so as to address the issues emerging from the economic reforms initiated since the early 1990s, the growing number of part-time farmers and homestead farms of NR in the state. Though it is true that replacement of NR by the competing crops appears to be a remote possibility in the traditional regions for the present, the

designing of appropriate policy inputs to ensure economic viability and agronomic sustainability poses serious policy challenges in the era of market integration.

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APPENDIX 1

Instability index is a tool employed to measure the instability of a variable. There are various methods used to measure the extent of instability of a variable. Coefficient of variation (CV), the usual measure of instability, has generally been considered as a more realistic measure that takes the time trend into account. But usually when time-series data for a variable show some kind of trend, which may be linear or non-linear, CV does not take into account any such time trends of the data while measuring instability in the variate value. Hence, variability was measured in relative terms by the Cuddy-Della Valle index, which is used as a suitable measure of variability in time-series data characterised by long-term trends. Since the simple coefficient of variation over-estimates the level of instability in time-series data characterised by long-term trends, the Cuddy-Della Valle index corrects the coefficient of variation by

$$CV = (CV^*)\,(1-R^2)^{0.5}$$

where CV* is simple estimate of the coefficient of variation (in per cent), and R^2 is coefficient of determination from a time-trend regression adjusted by the number of degrees of freedom.

APPENDIX 2

Periodwise growth is calculated using dummy variable (Dandekar, 1980) and is of the form:

$$\ln Y = a + bt + c\,(Dt) + u_t$$

where D = 0, for the first sub-period and
= 1, otherwise.

If there is any break in the period, growth rate is estimated by employing Kinked exponential function (Boyce, 1986). It is of the form:

$$\ln Y = a_1 + b_1\,(D_1 t + D_2 t) + b_2\,(D_2 t - D_2 k) + u_t$$

where D_1 = 1, for the first period, = 0, otherwise.
D_2 = 1, for the second period, = 0, otherwise.

NOTES

1. The major institutional factors include R&D support at various levels of operations, network of extension programmes, production and marketing subsidies. The extent of deviations from the perceived relationship varies across crops and countries. For a region-specific case study on natural rubber, see George *et al.*, 1988 and George, 1999.

2. An explicitly articulated commitment to stabilise prices at remunerative levels during the inter-war years was rooted in the dominant control over production and marketing of the major commodities produced in the developing countries by the erstwhile colonial powers.

3. The latest victim is the International Natural Rubber Agreement (INRA) which was terminated on October 13, 1999.

4. For instance, the world market price of natural rubber exhibited a significant negative trend growth rate of 1.48 per cent during the 19-year period between 1980-98.

5. Comparable time-series data on area under natural rubber cultivation are available only for Malaysia, Indonesia and India for the period 1975-95. While the rates of growth of area under the crop in Kerala and India were 4.07 and 4.50 per cent respectively, it was only 2.03 per cent in Indonesia and a negative growth rate of 0.07 per cent was observed in the case of Malaysia.

6. The price regulation scheme initiated in India in 1942 under the Defence of India Rule was the precursor to subsequent market intervention schemes operated by the Government in different forms under various historical contexts.

7. The gestation period of natural rubber varies from six to seven years.

8. The choice of the period is based on the fact that with the launching of economic reforms in the country in July 1991, there have been considerable changes in the institutional support mechanisms across the crops.

9. More than 83 per cent of the area under small holdings adopted the HYV RRII 105, while in the estate sector the adoption rate was 33 per cent during the late 1980s (Joseph *et al.*, 1999).

10. Although sectorwise data on area under natural rubber in the state are available only from 1960-61, the state accounted for about 94 per cent of the total area under the crop in India even during 1955-56. Therefore, the sectorwise changes in the area under the crop at the all-India level basically reflected changes in Kerala (see George *et al.*, 1988).

11. While the sectoral shift in terms of sub-division and fragmentation was basically to escape the labour welfare obligations under the Plantation Labour Act, the crop shift had been accelerated by the exemption given to plantation crops from the land ceiling.

12. At the all-India level, the area under the small holdings sector surpassed the estate area during 1957-58.

13. The cash subsidy under the integrated scheme was Rs.5000/ha for the small holdings and Rs.3000/ha for the large estates in 1980.

14. The share of planting subsidy in the estimated development cost was more than 25 per cent during the 1980s. However, it declined to around 16 per cent during the year 2000.

15. In India, holdings having an area of more than 20.23 hectares belong to the estate sector. The major forms of ownership in the estate sector are public limited companies, private limited companies, public sector corporations, proprietary concerns and partnership firms.

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