PRODUCTION AND TRADE COMPETITIVE ADVANTAGES OF NATURAL RUBBER IN INDIA

By
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THESIS

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DECLARATION

I hereby declare that the thesis entitled "Production and Trade Competitive Advantages of Natural Rubber in India" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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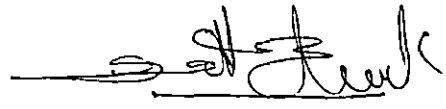

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To the fond memory of my younger brother, U. Prabhath

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LIST OF ABBREVIATIONS

Sl.no	Abbreviation	Expansion
1.	AAD	Agreement on Anti-Dumping Duties
2.	ANRPC	Association of Natural Rubber Producing Countries
3.	AoA	Agreement on Agriculture
4.	AoS	Agreement on Safeguards
5.	ASCM	Agreement on Subsidies and Countervailing measures
6.	BCR	Benefit Cost Ratio
7	BoP	Balance of Payments
8.	c.i.f	Cost insurance freight
9.	CGR	Compound Growth Rate
10.	CI	Capital Investment
11.	CIF	Cash inflow
12.	CMA	Constant Market Analysis
13.	COF	Cash outflow
14.	CV	Coefficient of Variation
15.	CWA	Classical Welfare Analysis
16.	DEPB	Duty Entitlement Pass Book
17.	DFRC	Duty Free Replenishment Certificate
18.	DRC	Domestic Resource Cost
19.	DRCR	Domestic resource cost ratio
20.	DSB	Dispute Settlement Body
21.	EPC	Effective Protection Coefficient
22.	EPDM	Ethylene Propylene Diene Monomer
23.	EPR	Export Performance Ratio
24.	f.o.b	Free on Board
25.	GATT	General Agreement on Tariffs and Trade
26.	GNP	Gross National Product
27.	HS	Harmonized System

28.	INR	Initial Negotiating Rights
29.	IRR	Internal Rate of Return
30.	MFN	Most Favored Nation
31.	NBR	Acro-nitrile-butadiene latex
32.	NPC	Nominal protection coefficient
33.	NPR	Nominal Protection Rate
34.	NPV	Net Present Value
35.	NR	Natural Rubber
36.	OGL	Open General License
37.	PAM	Policy Analysis Matrix
38.	PBP	Pay Back Period
39.	PSE	Producer Subsidy Equivalent
40.	QR	Quantitative Restrictions
41.	RPDS	Rubber Plantation Development scheme
42.	RPS	Rubber Producing Societies
43.	RR	Reclaimed Rubber
44.	RSS	Ribbed Smoked Sheet
45.	SAARC	South Asian Association for Regional Co-operation
46.	SAPTA	SARRC Preferential Trade Agreement
47.	SBR	Styrene Butadiene Rubber
48.	SM	Safeguard Measure
49.	SR	Synthetic Rubber
50.	SSG	Special Safeguard provisions
51.	SSM	Special Safeguard Measure
52.	TRIPS	Trade Related Intellectual Property Rights
53.	TSR	Technically Specified Rubber
54.	UNCTAD	United Nations Conference on Trade and Development
55.	WTO	World Trade Organization

INTRODUCTION

1. INTRODUCTION

Rubber *(Havea brasiliensis)*, is an indigenous forest tree belonging to the tropical rain forest of Central and South America. It is the major source of natural rubber (NR) meeting about 99 per cent of the global natural rubber requirement. It is one of the most recently domesticated crop species in the world. Currently it is the prime source of raw material for about 35,000 products (Rubber Board, 2001). Though it was introduced in the tropical Asia in the year 1876, it had its commercial beginning in India only in 1902.

The growth attained by the Indian rubber plantation industry since its commercial beginning in 1902 has no parallel in the agricultural scenario in the country. In terms of the productivity, growth in area and production and the extent of price realization at the farm gate, the Indian rubber plantation industry is ahead of other major natural rubber producing countries in the World (Lalithakumari and Jacob, 2000). Owning to the pace of development of the industrial sector the demand for natural rubber has been dynamic.

The growth attained by the Indian rubber plantation industry has been mainly through the expansion of rubber cultivation in Kerala, which is India's premier plantation State (Thomas and Panikkar, 2000). Among the plantation crops, which occupies 46 per cent of the total area and 40 per cent of the production, rubber tree occupies 15.75 per cent of the total cropped area accounting for about one third of the agricultural income of the State (Government of Kerala, 2001). Around a crore of people depend on this crop directly or indirectly for their livelihood.

1.1 PRODUCTION SECTOR

1.1.1 **Area**

In terms of its size and different structural parameters, Indian rubber industry passed through many vicissitudes and attained a fairly significant position in the global arena. India currently stands in the Fifth position with 522670 hectares under rubber cultivation, the leading countries being Indonesia (3,37, 20,00 ha), Thailand (19,80,000 ha), Malaysia (1,43, 10,00 ha) and China (6,18, 000 ha) (Rubber Board, 2002).

Table 1.1 Area, production and productivity of rubber on India

Year	Area (ha)	Tapped area (ha)	Production (tonnes)	Yield (Kg / ha)
1902-03	200	-	-	-
1910-11	11900	-	80	-
1925-26	30866	-	6400	-
1930-31	48000	-	6500	-
1940-41	47200	-	16100	-
1950-51	74915	55800	15800	284
1960-61	143905	70253	25697	365
1965-66	186713	112709	50530	448
1970-71	217198	141176	92171	653
1975-76	235876	178480	137750	772
1980-81	284166	194245	153100	788
1985-86	382831	223347	200465	898
1990-91	475083	306413	329615	1076
1991-92	488514	324540	366745	1130
1992-93	499374	330500	393490	1191
1993-94	508420	338550	435160	1285
1994-95	515547	346270	471815	1362
1995-96	524075	356444	506910	1422
1996-97	533246	365580	549425	1503
1997-98	544534	372970	583830	1549
1998-99	554000	387100	605045	1563
1999-00	558584	394800	622265	1576
2000-01	562670	399901	630405	1576
2001-02	566558	400713	631400	1576

Source : Burger *et al,* 1995, Rubber Board, 2003

The area under rubber cultivation has increased constantly over the decades in India. The progress is more pronounced during the nineteen fifties and nineteen sixties (Table 1.1). This was partly because of the fact that rubber crop which was then confined to the State of Kerala, was exempted from the purview of the land ceiling and a considerable area under coconut and arecanut was brought under rubber (Lalithakumari and Jacob, 2000). However, owing to the prolonged sluggishness in the rubber market during the nineteen seventies, rubber had a set back in area expansion. The situation however changed by the late nineteen seventies and there was a boom in the planting activity. Though there was short-term fluctuation, the pace of area expansion continued and by 2000-01 the total area under rubber was 5,62,670 ha with 3,99,901 ha under tapping. (Rubber Board, 2003)

1.1.2 Production and Productivity

The world production of natural rubber during 2001 was 7.11 million tonnes (Table 1.2). Thailand was the largest producer of natural rubber by accounting for 32.21 per cent of the global output, followed by Indonesia (22.18 %), Malaysia (7.69 %) and India (7.69 %).

Table 1.2 **Production of natural rubber in the main producing countries.**

(in '000 tonnes)

Country	1985	1990	1995	1997	2000	2001(p)
Thailand	724	1275	1805	2033	2346	2284
Indonesia	1130	1262	1455	1505	1501	1577
Malaysia	1470	1291	1089	971	615	547
India	198	324	500	580	629	632
China	188	264	424	444*	445*	451*
Philippines	NA	61	60	66	67*	68
Nigeria	52	152	116	65	55	50
Sri Lanka	138	113	106	106	88	86
Vietnam	52	103	154	212	291	317
Cote d'Ivoire	41	69	77	108	113*	109*
Liberia	84	19	13	67	105	109
Brazil	40	31	44	61	88	90
World	**4400**	**5120**	**6040**	**6470**	**6750**	**7110**

* Estimated, NA – Not available separately, P - Provisional. Source: Rubber Board, 2003

Though in terms of production of natural rubber, India's position is only fourth, the country has attained the first position in yield among the major rubber producing countries, with 1576 Kg / ha in the year 2000-01. Kerala is the major rubber producing state in India, accounting for 91.91 per cent in the total production of rubber in India (Rubber Board 2003). Kerala's yield of 1612 Kg / ha in the year 2000-01 was higher than national average of 1576 kg/ha (Rubber Board, 2002).

One characteristic feature of the natural rubber production in India is the dominance of small-holdings. The share of area under the small-holdings sector has been increasing over time. Currently it accounts for 86 per cent of the total average, whereas the estate sector comprising plantations above 20.23 ha has share of only 14 per cent (Rubber board, 2001).

1.2 CONSUMPTION SECTOR

The consumption of natural rubber in the world during the year 2001 was 7.07 million tonnes, with United States of America (USA), China, Japan and India being the first four major consumer of the natural rubber in the world. (Table 1.3). India currently occupies the fifth position after USA, China, Japan and Germany in the consumption of rubber (Lalithakumari and Jacob, 2000).

Table 1.3. Consumption of natural rubber in main consuming countries

(in Thousand tonnes)

Country	1985	1990	1995	1997	2000	2001 (p)
USA	764	808	1004	1044*	1193*	972*
Japan	540	677	692	713	752	729
China*	415	600	780	910	1080	1215
India	233	358	517	572	638	631
Korea Rep*	155	255	300	302	332	332
Malaysia	69	184	327	327	345	330
Germany**	202	209	212	212*	247*	244*
France	156	179	176	192	309	282
Brazil	98	124	155	161	221	218
U.K*	126	136	118	119	133	107
Italy	127	130	102	117	139	136
Taiwan	84	105	103	105	97	94
C.I.S	210	150	13	9*	36*	33*
World	**4430**	**5210**	**5950**	**6470**	**7340**	**7070**

* Estimated, p – provisional, ** Up to 1990 Federal republic of Germany
For C.I.S, data before 1992 refer to the former U.S.S.R
Source : Rubber Board, 2003

The consumption of natural rubber in India has been steadily increasing from 0.87 lakh tonnes in 1970-71 to 1.74 lakh tonnes during 1980-81 to 6.28 lakh tonnes during 1999 - 2000. The production in the corresponding years have been 0.92 lakh tonnes, 1.53 lakh tonnes and 6.22 lakh tonnes respectively, leaving a production deficit of 5845 metric tonnes currently (The Rubber Board, 2001).

Another unique characteristic of India among the leading natural rubber consuming is its relatively low level of per capita consumption. It was only 0.70 Kg during the year 1997 as compared to countries like Japan, United States and Canada whose per capita consumption is more than 12 Kg. (The Rubber Board, 2003).

1.3. IMPACT OF LIBERALIZATION

The economic reforms that were introduced by the Government of India since 1991 emerged as the major factor influencing the price of rubber during the 1990s. The liberalized policies of the government in respect of the international trading on rubber and rubber products gave the country a relatively free access to the world market. Consequentially, ups and downs in the world market began to be reflected in India also. Thus after 1995, price movements in the domestic market fluctuated in tandem with the world market. The observed trends in the domestic natural rubber prices since 1992 have been in sharp contrast to its insulated and protected status during the pre-reform and pre-World Trade Organization (WTO) phase. (Joseph and George, 2002). The issue captured the attention of the media, since the fall in domestic natural rubber prices from the peak level in 1995-96 had resulted in a hue and cry from the farmer lobby. The crisis in the tea, coffee and the spices sector gave a general feeling that the agricultural sector will undergo an unprecedented depression.

Without any scientific study, people made impressionist views and held the WTO responsible for each and every set back in the economy. This underlines the need for examining the provisions and the compliance of the WTO objectively to demystify the popular myths and beliefs.

1.3 OBJECTIVE OF THE STUDY

The present study entitled "**Production and trade competitive advantages of natural rubber in India**" is undertaken against this background, with the following specific objectives:

1. To examine the emerging trends in production, consumption, export and import of natural rubber

2. To assess the competitive advantages and disadvantages in the specific context of the WTO regime

1.5 LIMITATIONS OF THE STUDY

A part of the data was collected by survey method by interviewing sample farmers. Hence, the objectivity of the data is limited to the extent the respondents were able to recollect from without recall bias as most farmers, except a few, did not maintain any farm records. However, every effort was made to minimise the error by cross-questioning and cross checking the details provided. Secondly post-WTO data were available for six years from 1995-96 only. This limited the scope of the econometric analysis. In order to examine the issue of dumping, domestic price of natural rubber in Sri Lanka, Thailand, Indonesia and Malaysia were required during the period from 1985-86 to 2001-02. Due to the data non-availability, the exercise could not be undertaken.

1.6. ORGANISATION OF THE THESIS

Besides the introductory chapter, the study is organised into five chapters. Chapter two is a review of literature relevant to the study. Chapter three describes the profile of the study area, the methodological framework, analytical tools, and conceptual issues. The results of the study and the discussion of the findings are presented in chapter four. The fifth chapter summarises the main findings and conclusions drawn from the analysis, along with the policy implications.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

A comprehensive review of past studies is highly essential for proper understanding of the concepts, research design and method of analysis of research. Hence a review of past studies related to objectives of the study is presented in this chapter. For convenience and clarity, this chapter is divided in to four sections as given below:

1. Trends in production of natural rubber
2. Trends in consumption of natural rubber
3. Trends in export and import of natural rubber
4. Comparative and Competitive advantages
5. WTO related issues

2.1 TRENDS IN PRODUCTION

Rubber cultivation in India is overwhelmingly small holder oriented. The small holders account for 85 per cent of the total cultivated area in India. The average size of the small-holding is less than 0.50 ha (Mathew, 1995).

The production of natural rubber has recorded an unprecedented improvement during the eighth plan period. From 3.67 lakh tonnes, it improved to 5.07 lakh tonnes during 1995-96. The average annual growth rate worked out to 8.1 per cent. The productivity of rubber plantations measured in yield per hectare has improved substantially during this period (Mathew, 1996).

The index numbers of agricultural production (base triennium ending 1981-82 = 100) during 1965-66 to 2000-01 show that rubber recorded the highest growth in production among all-important crops in India (Menon 2002). He viewed that from 1955-56 there was a dramatic all around progress of natural rubber production in India within a period of 45 years upto 2000-01. He concluded that area under rubber went up from 97,339 ha in 1956-57 to 5,62, 670 ha in 2000-01,representing an increase of 478 per cent. The production during the corresponding period shot up by 26 times from 24,060 tonnes to 630,405 tonnes, which had brought up India's ranking in production among natural rubber producing countries from eleventh in 1956 to third in 2000. Productivity gain during the period from 1956-57 to 2000-02 was from 333 kg/ ha to 1,576 kg/ha, which represented a handsome gain rise of 373 per cent.

Expansion of area under rubber during the fifties, sixties and seventies was a result of plantation development schemes implemented by the Rubber Board. The thrust upto 1978 was for replanting old and uneconomic trees. The widening gap between production and consumption compelled the Government of India to introduce a massive area expansion programme, the Rubber Plantation Development Scheme (RPDS) in 1980. It provided financial and technical assistance to small growers in order to enable them to raise scientifically managed plantations. During the nineties, the rate of expansion of areas under rubber reduced drastically, resulting in reduction in production also. The reduction in the rate of production could be attributed to the decline in the extent of tapped area and small growers neglecting short term productivity enhancement measures due to price fall (Kumar, 2002).

2.2 TRENDS IN CONSUMPTION OF NATURAL RUBBER

The demand for rubber depends on the growth in the production of rubber goods absorbed domestically as well those exported. Consumption of natural rubber has shot up from less than 20,000 tonnes in 1950-51 to 5.61 lakh tonnes in 1996-97. At the end of March 1997, there were 5, 588 licensed rubber goods manufactures. A majority of them were small-scale operators (consuming less than 100 tonnes of natural rubber per year). About 62 per cent of the consumption is accounted by 100 large scale manufactures. (Mathew, 1997)

The rubber-manufacturing sector in India has been undergoing a recession from 1997-98 onwards. The decline in demand is mainly due to a slow down in the industrial growth in the country and the consequent slackness in the automobile industry, which is the dominant end use segment of natural rubber in India. During 2001-02, the Indian rubber goods manufacturing industry consumed 6,38,210 tonnes of natural rubber as against 6,31,475 during 2000-02 and 6,28,110 tonnes during 1999-2000. The consumption of natural rubber in the auto-tyre manufacturing units posted a negative growth of (-) 0.4 percent during and (-) 1.7 per cent during the years 2000-02 and 2000-01respectively (Desalphine, 2001).

The consumption pattern of natural rubber and synthetic rubber underwent tremendous changes over time. During the fifties, the share of synthetic rubber (SR) in global consumption was 40 per cent. It then soared to 76 per cent by 1979. It was then widely felt that natural rubber would soon be totally replaced by synthetic rubber. However, synthetic rubber is no more considered a threat to natural rubber because of the difference in the cost of production and output prices. Both are now considered necessary and complement each other (Menon, 2002).

In India, 80 per cent of the elastomer requirement is met by natural rubber with synthetic rubber accounting for only 20 per cent. The global trend is just the reverse. Globally, 41 per cent of the elastomer need is met by natural rubber and 59 per cent by synthetic rubber. The automobile sector dominates the consumption of natural rubber in India, with automobile tyres and tubes accounting for 45.2 per cent of the natural rubber consumption. The footwear, belts and hoses accounted for 11.2 per cent and 6.1 per cent respectively of natural rubber consumption during 2000-01 (Kumar, 2002).

2.3 TRENDS IN EXPORT AND IMPORT OF NATURAL RUBBER

Till 1950, India was a net exporter of natural rubber. In 1973-74, 1974-75, 1976-77 and 1977-78 small quantities were exported mainly to remove the glut in the domestic market. During the eighties, it imported rubber to supplement domestic production. The recession in demand and steady increase in domestic production forced the export of 11, 833 tonnes of natural rubber in 1991-92. However, quality improvement of raw rubber and its products are the major challenge of globalising Indian rubber industry (Lalithambika, 1994).

The restrictions on export of rubber were removed in 1992. India could not make headway owing to many reasons. Firstly, the international price of natural rubber was generally lower than Indian price. Secondly, India is not a regular player in the export market of natural rubber. Inadequacy of information about overseas markets, inefficiency of existing marketing system and insufficient infrastructure were other impediments in the extent of natural rubber (Rubber Board, 2002).

There were methodological differences among researchers for estimating the trend and growth rate in production and productivity of agricultural commodities. The following literature review tries to highlight the different methodologies used by various workers for calculating the trend and growth rate.

Giri *et al* (1966) studied the contributions of land, irrigation and fertilizer in the growth of crop output at the all India level during the period from 1951-52 to 1962-63. They fitted the Cobb-Douglas production function to the indices of variable, the first difference of their indices, productivity per unit area of gross area as dependable variable and irrigated area and fertilizer used as independent variable. They calculated the compound growth rate and linear growth rates as 3.5 and 3.9 percent per annum respectively. The analysis revealed that land still continues to be a major contributor to the growth of crop output in India and irrigation and fertilizer used are yet to play their significant role.

Growth rates can be estimated by two functional forms, *viz.*, linear and compound. Because of the standardising procedure used in linear rates, they are higher than compound rate for all series. Though linear growth rates are easier to compute, an exponential form is superior, because it avoids the arbitrary element present in choosing a standardising base for the linear growth rates (Blyn, 1967).

Minhas and Srinivasan (1968) calculated growth rate of food grain production based on fitted trend line curve excluding the years 1965-66 and 1966-67 because these two years were abnormal years and recorded bumper harvests. The fitted trend lines indicated that from 1950-51 to 1964-65 the annual growth rate for food grains was 3.21 per cent. For wheat, it was 3.89 per cent and for rice, it was 3.63 per cent.

Rudra (1970) cautioned that if certain model is not suggested by any theoretical considerations which give it prior plausibility, even a good statistical fit may not be enough for its acceptance. Even when there is a smooth trend there can be number of different functional forms to choose from. His study concluded that for manufacturing industries the Gompertz curve yielded better fit, where as for agriculture, both Gompertz and semi-logarithmic gave almost equally good fits. The study suggested that there was slight tendency towards slowing down the rate of growth in the case of agriculture, though a constant rate of growth was equally suggested.

Reddy, (1978) approached the problem of estimating growth rates by fitting a particular growth curve, which appeared quite satisfactory based on the measures of goodness of fit, *viz.*, the adjusted R^2, Durbin-Watson statistic and standard errors of regression equation. But this type of empirical approach may also lead to misleading picture of underlying phenomena. Hence, he considered it ideal to choose an equation, which provided the estimate of growth rates for given period with minimum possible standard errors. He pointed out that the problem of estimating growth rates was approached in the past in a ritualistic fashion of fitting a particular growth curve.

Srinivasan (1979) used the Gompertz curve to analyse the trend in agriculture in India during 1949-50 to 1977-78. Two sub periods were distinguished, *viz* the pre and the post green revolution period. The study revealed that there has been a decline in rate of growth of gross sown area in particular under non-food crops in the decade starting from 1967-68, compared to the fifteen year ending in 1965-66. The output of food crops and all crops grew more or less uniformly over the entire period with no evidence of either acceleration or deceleration.

Rao *et al* (1980) in their study developed a strategy to separate the years included in the time series in to three groups, 'normal', 'peak', and 'trough' years and recommended the use of only the normal years to estimate trend lines after eliminating the 'outliers'. After obtaining the trend line, the peak and trough years were brought back into the picture to see how weather-effects pull production away from the trend line. It was seen that trend lines fitted by such a method was better in most cases and reflected in high R^2 values as compared to R^2 values of 'all years'.

According to Mukherjee and Vaidyanathan (1980), when there are more than one functional form which satisfy the assumptions about behaviour of residuals it is appropriate to choose the one with higher adjusted R^2, which permits comparison of explanatory variables and are uniformly better that their corresponding trend fits

Rao (1980) identified the methodological problems confronted while measuring agricultural growth rates like separating growth from fluctuations in relatively short span of time series data. He cautioned that alternate functional form thrives best in situations of plentiful data. In addition, while choosing the alternate function, we have to take into account of a totality of information regarding statistical measures of goodness of fit, accuracy of growth rates, predicative capability of estimated growth curve and *apriori* theoretical reasoning. Prior screening of agricultural time series data for excluding periods marked by sudden concentrated technological changes could result in better estimation of trend and growth rate.

Krishnaji (1980) viewed that R^2 values is not a reliable guide for choosing the correct functional form from a set of pre-specified trend lines. He also argued that inferences on patterns of growth or magnitude of fluctuations drawn from fitted trend are not valid because it ignores the sources of variation in the underlying variables.

Thus, it can be seen that there was no general agreement among the researchers regarding the underlying assumptions of trend fitting based on different functional forms. It was under such circumstances that workers started employing compound growth rate (CGR) to capture the changing trend in parameters over a time period.

According to Rath (1980), compound growth rate (CGR) is the more appropriate for measuring growth rate in a biological production process like agriculture. He concluded that the sustained growth of food grains production during the 23 years study period (1955-56 to 1977-78) was entirely due to the cereals. He also concluded that agricultural production has not exceeded 3 per cent rate of growth and cereals have not exceeded 3.5 per cent growth over a period of decade in India.

Biradar and Annamali (1982), studied the compound growth rate in area, production and productivity of sweet potato from 1966-67 to 1977-78. The study revealed a nominal increase of 0.50 per cent in case of area and low growth rate of 0.20 per cent in case of production. The productivity on all India level showed a negative annual growth rate of (-) 0.35 per cent.

Salam *et al* (1992) analysed the trends in cashew production in Kerala. They fitted trend lines to indices of area, production and productivity for the whole period and two sub periods using linear, quadratic, exponential, modified exponential and logistic functions. As the functional forms did not yield a satisfactory fit, a three-year moving average was used to depict the trend. The compound growth rate was estimated and it was found that area under cashew increased rapidly from 1975-76 to 1983-84 and declined there after. The productivity showed a declining trend in the late seventies and eighties. The cashew production in the state showed a steady increase from 1962 to 1975 after which there was a declining trend

The usual method for estimation of period wise growth rates is to estimate separate regressions for each period. But there are lot of pitfalls in such an exercise and Boyce (1986) suggested that period wise growth rates becomes more reliable if it can be estimated through a Kinked exponential function, which imposes a continuity restriction at the break points between two sub-periods.

Kannan and Pushpagadan (1988) studied the agricultural stagnation of Kerala, during the period from 1962-63 to 1985-86, by dividing it in to two phases, *viz*, as period I from 1962-63 to 1974-75 and as period II from 1975-76 to 1985-8. They used the Kinked exponential function given by Boyce (1986), to find out the growth rates in the two periods by component wise, *viz.*, area, production and productivity of important crops. The study revealed that agricultural sector showed stagnation in production during the study period.

Mohan and George (1993) used kinked exponential model to estimate the growth rate of area, output and yield of natural rubber during the period from 1955-56 to 1976-77 (period I) and 1977-78 to 1991-92 (period II). The study revealed that rate of growth in area output and yield was lower in the second period as compared to the first period, suggesting that the industry is reaching a stabilization point.

There were also attempts to decompose the growth in output into various components. Efforts were made to identify the sources of growth in such decomposition analysis. A review of relevant literature shows that the decomposition models used by workers were mainly of two types namely, the additive and multiplicative model. The additive models decompose the absolute increase in output and hence the linear growth in output while the multiplicative models decompose the proportionate increase in output and hence uses the compound growth in output.

Minhas and Viadyanathan (1965) decomposed the agricultural growth into area, yield component, component on cropping pattern and a residual component showing an interaction between cropping pattern and yield. They developed the additive scheme of decomposition which was later developed into seven components version by Minhas (1966) and subsequently used by Misra (1971) and Sondhi and Singh (1975).

Parikh (1966) employed, a multiplicative scheme in decomposition of agricultural growth. He attempted to decompose the growth rates into components such as the extension of irrigation, extension of area, increasing use of chemical fertilizers and other technical inputs at the State level over the period from 1952-53 to 1961-62. The study revealed that almost in all cases, area and change in cropping pattern explained most of the growth rates.

Sagar (1978) decomposed the growth of agricultural productivity in Rajasthan into technological factors such as irrigation, fertilizers and high yielding varieties of seed. The study revealed that out of the overall level of agricultural productivity, ninety seven per cent was contributed by yield increase alone. It was also found that fertilizers were the largest source of growth contributor of yield, accounting 30 per cent of yield growth.

Bhat *et al* (1986), evaluated the growth rates of area and productivity of major crops in Jammu and Kashmir during 1970-71 to 1983-84. They also examined the relative contribution of area, yield, cropping pattern and their interaction towards the additional food grains production in the State. The compound growth rate was worked by fitting a function of exponential form as it gave better fit to the data on all cases. The decomposition scheme studies the area effect, yield effect and the interaction between them. The study revealed oilseeds have highest growth rate for

area followed by rice and wheat. The decomposition analysis revealed that crop pattern changes of State have not contributed to overall food grain production.

Lakshmi and Pal (1988) analysed the growth of agricultural output in Kerala during the period from 1952-53 to 1984-85 in terms of component elements. The additive scheme of decomposition of three elements reflecting the changes in yield, cropping pattern and their interaction was worked out for area, production and yield figures by fitting the exponential function. The study revealed that production of various crops under consideration has positive growth of more than unity except in case of pepper and coconut. Analysis of component elements for the period revealed that nearly 50 per cent of change in crop out put in Kerala is due to total area under ten crops and 42 percent through change in yield of concerned crops.

Thomas *et al*, (1991) in their study analysed the trend in area, production and productivity of tapioca by fitting a semi-logarithmic model to index numbers of area, production and productivity for the entire period of 1960-61 to 1986-87. To study the inter-decadal growth, the entire period was divided into three phases. The study revealed that acreage under tapioca showed a declining trend. Though the growth rate of area was negative, the positive growth rate of productivity (2.45 percent) has offset the negative impact of area. The trend analysis for the period of eighties (1980-81 to 1986-87) revealed that effect of technology has very little impact on production.

Kumar and Pillai, (1994) in their study of trend in area, production and productivity of rubber plantation industry in Kerala, used the multiplicative model to decompose the growth in rubber production into area effect and yield effect. The analysis revealed that during the study period from 1955-56 to 1991-92, the area effect contributed more to output growth rate than yield effect.

Lekshmi *et al* (1996) employed Boyce (1986) method of kinked exponential function to estimate the period wise growth rate of natural rubber prices. They also attempted to delineate the secular trend of natural rubber price, covering a period of 27 years from 1968 to 1994-95. The trend in price was examined by using a random test supplemented by an analysis of three-year moving average intended to even the seasonal fluctuations to capture the secular trend in price movements. A semi log quadratic equation was fitted to detect the direction of price movements. The analysis revealed that natural rubber price in India did not show any statistically significant trend to move consistently towards particular direction in long run. However, two distinct phases could be identified in natural rubber price movements for the period. The natural rubber price grew at a rate of 7.6 per cent during the entire period, however growth for the first 17 years was 9.1 per cent.

2.4. COMPARATIVE AND COMPETITIVE ADVANTAGES

The theory of comparative advantage in its simplest form states that a nation can enhance efficiency in resource use and hence net welfare by producing and exporting commodities in which it is relatively efficient and importing commodities in which it is relatively not efficient (Lipsey,1975; Samuelson, 1978 and Gulati *et al* 1994).

Pearson and Meyer (1974) studied the comparative advantage of African coffee producers in Uganda, Ethiopia, Tanzania, and Ivory Coast using the Domestic Resource Cost (DRC) ratio. The study revealed that Uganda had the greatest comparative advantage in the production of coffee followed by Ethiopia and Tanzania. Ivory Coast had the least comparative advantage in coffee production among the countries considered.

Gotrch and Brown (1980) used the Domestic Resource Cost (DRC) to analyse the comparative advantage of crops in Pakistan from 1960 to 1976.The study revealed that incentives to keep sugarcane in the cropping pattern would result in misuse of domestic resource and hence led to a comparative disadvantage. Their study also revealed that comparative advantage of various crop combinations is seriously influenced by methods of production adopted.

Appleyard, (1987) used the DRC ratio to analyze the comparative advantage of Pakistan Agriculture. The study revealed that there was comparative advantage for crops like basmati rice, wheat, seed cotton and sugar cane. However, comparative advantage did not exist for crops like traditional varieties of paddy, cotton and maize.

Tweeten (1992) reviewed the different measures to assess competitive and comparative advantage. According to him the four most widely used measures from the least to most comprehensive were the Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC), Producer (Consumer) Subsidy Equivalent (PSE) and the Classical Welfare Analysis (CWA). He concluded the last three were ideal to measure competitive advantage and protection under different assumptions, the Domestic Resource Cost Ratio (DRC)was a good measure for measuring the comparative advantage.

Gozales *et al* (1993) analysed the comparative advantage of Indonesian food crops using the Domestic Resource Cost (DRC) method. Five crops *viz.*, rice, corn, soybean, sugarcane and cassava were considered for the study. The results revealed that Indonesia had comparative advantage in rice production, but did not have comparative advantage in rice exports. Corn was found to have better export potential than rice crop. The result also indicated that soybean was not a comparatively advantageous crop while, cassava was an economically export efficient crop.

Naik (2001a) studied the comparative advantage of cotton in India using the DRC ratio. The study revealed that comparative advantage in production of cotton was eroding over time in all the major cotton producing States and that only few States are now retaining the comparative advantage for cotton production in India.

Using the DRC analysis Naik (2001b), calculated the comparative advantage of Indian wheat during the four years viz 1995-96, 1996-97, 1997-98 and 1998-99 for five sates namely Madhya Pradesh, Gujarat, Haryana, Punjab and Rajasthan. His study revealed that comparative advantage in producing wheat by these states are declining. He warned that if the present trend continues, Indian wheat would be non-competitive in the world market and this would lead to heavy imports and consequent pressure on domestic price would occur.

Porter (1990) argued that the theory of international trade must move beyond the comparative advantage to the competitive advantage. The idea of competitive advantage is more comprehensive as it involves segmented markets, differential products, technology differences and economics of scale. He concluded that price cum cost comparisons are the best preliminary indicators of competitiveness.

Gulati *et al* (1994) calculated the export competitiveness of 17 agricultural commodities from India using the Nominal Protection Coefficient (NPC) methodology. They concluded that rice among the cereals, grapes, banana and sapota among fruits, tomato among the vegetables and mushrooms among processed vegetables were highly export competitive. Sorghum among cereals and apples juice among processed fruits were not competitive during the study period.

Umapathi *et al* (1995) calculated the comparative advantage of DCH 32 seed cotton variety from Karnataka during the period from 1983-84 to 1991-92, using the Nominal Protection Coefficient (NPC). The results revealed that the government policy had discriminated against the cotton cultivators of the study area and that DCH –32 seed cotton variety was an efficient export competitive crop.

Dahiya (2001) analysed the competitiveness of potato export from India during a period from 1992 to 2000 using the Nominal Protection Coefficient (NPC). The study showed that during the years 1994, 1995, 1997, 1999, and 2000, the NPC was less than one and hence competitive in exports during these year. He concluded that cash compensatory scheme for non-competitive years, strengthening the infrastructure, higher bound rates and export oriented research and sound database on prices grade standards, Sanitary and Phyto-sanitary standards are policy implications for promotion of potato exports.

The indicators such as Effective Protection Coefficient (EPC), Producer Subsidy Equivalent (PSE), Policy Analysis Matrix (PAM) and Constant Market Share (CMS) were also used by different authors to study the trade competitiveness of different crops. However, the uses of these measures were limited by underlying assumptions.

Alias and Suleiman (1993), used the Constant Market Share (CMS) approach to study the export competitiveness of natural rubber in Thailand, Malaysia and Indonesia. The study revealed that export from Thailand is the most competitive followed by Indonesia and Malaysia during the study period from 1976 to 1990. However, the CMS analysis has certain limitations. Firstly, the CMS analysis cannot elucidate the reasons for changing export competitiveness. The CMS analysis compares export competitiveness between two points of time and it cannot reveal the changing nature of competitiveness during a time period.

Jha (2000) used the Export Performance Ratio (EPR) to calculate the competitive advantage of several agricultural commodities in India. This study revealed that competitive advantage of traditional export items like tea has blurred during the study period. However, one of the limitations in the estimate of EPRs is that it imposes many export restricting assumptions in the analysis. It also does not explain the potential of commodities in an opening economy. Under these cases it be becomes imperative to depend on the superior measures of competitiveness like the NPC.

Datta and Gupta (2001) estimated the global competitiveness of Indian sugar industry using the NPC, EPC and ESC. The results of the study revealed that India was export competitive in terms of sugar.

2.5 WORLD TRADE ORGANIZATION (WTO) RELATED ISSUES

The World Trade Organization (WTO) came into existence on January 1995 as an international body for establishing multi-lateral framework for international trade. The main elements of WTO have been elaborated through various provisos of the General Agreement on Tariffs and Trade (GATT), 1994 and the other WTO agreements in different areas. Their declared objectives are to reduce trade-distorting factors in a phased manner and to promote a 'level playing field' for global trade.

Bhatia (1994) estimated the probable impact of WTO regime on Indian agriculture and found that the product specific support in India was negative for all crops for which minimum support price was declared except for ground nut, rape seed, sunflower and copra during the reference period of 1986-88. The aggregate

value of price support provided worked out to 12.1 per cent of the total value of production, and therefore he concluded that contrary to the general belief, Indian agriculture is net taxed – and not net subsidized.

With the liberalization of the procedural formalities the Indian manufactures cum exporters of rubber products would be included to import natural rubber if the domestic prices are higher than the cost insurance and freight (c.i.f) paid values, of the imported rubber. Therefore, the repercussions of the declining world natural rubber process and the liberalized export-import policies appeared to have serious impact on the dominant natural rubber production sector in India, as there were limitations in pursuing a protected price policy regime. (Mathew, 1999).

The natural rubber (unlike other plantation crops) is not covered by the WTO 'Agreement on Agriculture'. Consequently, natural rubber has no way of availing the 'softer provisions' of the 'Agreement on Agriculture. This special situation calls for equally special measures on the part of major rubber growing states, notably Kerala, which accounts for more than 85 per cent of the planted area and more than 90 per cent of production of natural rubber (Damodaran, 2001).

Comparatively higher cost of production of natural rubber in India has been identified as most disadvantageous factor for sustaining the country's natural rubber plantation industry under the WTO mandated regime. But the attainment of highest productivity among the major natural rubber producing countries, competitive structure of the domestic market and the presence of grass root level network for extension services and group activities in processing and marketing provide the country tremendous opportunities (Jacob, 2001)

Menon (2001) argued that there is no justification to exclude the natural rubber from the purview of agriculture. He pointed out that there was no

manufacturing operations involved as far as growers are concerned and the entire operation is purely agricultural. In fact the entire income from natural rubber is sheet form is treated as agricultural income and is taxed accordingly under the agricultural income tax Acts of the respective State governments. There are several disadvantages arising from rubber not being included in the category of agriculture under the WTO. The first disability is the bound rate of import duty allowed to be levied. While for tea the bound rate is 150 percent and for coffee, cardamom and pepper 100 per cent, for natural rubber is is as low as 25 per cent. Another aspect is that agricultural commodities come under the basket of 'green box' arising from which certain concessions including developmental subsidies could be extended and we may have certain bargaining powers on the ground that items in this box are eco-friendly in contrast to pollution-prone industrial products.

Rao (2001) cautioned on the need for extreme vigilance so as to take timely measure, within the provisions of the WTO, to arrest heavy import of the primary commodities. The developed countries are very well equipped with the technical and legal expertise and use these capabilities for advancing their case towards perpetuation of domestic support to agriculture and restriction of market access. On the other hand, the capabilities of developing countries, including India were found to be poor in this respect.

The natural rubber processing industry in the country has been evolved to cater to the requirements of a captive domestic market. The natural processing sector has been dominated by the sheet grades accounting for more than 72 per cent. In the emerging scenario with the removal of quantitative restrictions, the processing sector has been increasingly under serious compulsions to face the challenges posed by the potentially cheaper imports. Therefore, priority will have to be given to quality improvements and for reducing the cost of processing for all different marketable forms of rubber to be globally competitive (Desaplhine, 2001).

Joseph and George (2002) studied the implications of WTO agreements on natural rubber in India revealed that classification of natural rubber as an "industrial raw material" was unjustified. The study also revealed that natural rubber is 'price sensitive crop' that has to be closely monitored for any 'surge in imports' from other countries consequent to the elimination of quantitative restrictions (QRs). They advocate the ban on the import of natural rubber under the Advance-licensing Scheme (ALS) in order to protect the interest of the domestic producers.

Bhattacharyya (2002), after analyzing the global competitiveness of the Indian agriculture in the post WTO regime, concluded that the key to survival in a liberalized trade regime is competitiveness. He considers this as the only strategy to withstand increase in imports due to the removal of the quantitative restrictions.

MATERIALS AND METHODS

3.MATERIALS AND METHODS

Appropriate research design is pre-requisite to draw meaningful influences about any study. The present study on production and trade competitive advantages of natural rubber in India" was taken with the objective of examining the emerging trends in production, consumption, export and import of natural rubber with a view to identify competitive advantages and disadvantages in the specific context of the WTO regime. The present chapter is divided into two sections *viz.*, area of study and methodology

3.1 AREA OF STUDY

Agricultural production does not depend solely on the primary factors of production. It also depends largely on the geographical and agro-climatic conditions of the agro-ecology. Knowledge of the agro-climatic and socio-economic background of the study area is thus of paramount importance to analyze the data and draw meaningful conclusions. Hence the present section describes the agro-climatic, socio-economic backdrop of the study area before discussing the methodological issues. As the primary data that was required was generated from a cross sectional survey conduced in the Thrissur district of Kerala State, the agro-ecological characteristics of the study area is described first.

3.1.1 Location

Thrissur district is located in the central region of Kerala lying between the north latitude 10 ° and 10° 4' and east longitude 75°57' and 76°54'. It is bound by Malappuram district on the north, east by Palakkad district, Ernakulam and Idukki districts forming the southern boundary and Arabian Sea forming the western boundary. The district has a geographical area of 2993.90 km^2, which forms 7.8 per cent of the total area of the state. The district comprises of five taluks viz., Thrissur, Chavakkad, Kodungallur, Mukundapuram and Thalappily. There is one corporation, six municipalities, 17 community development blocks and 96

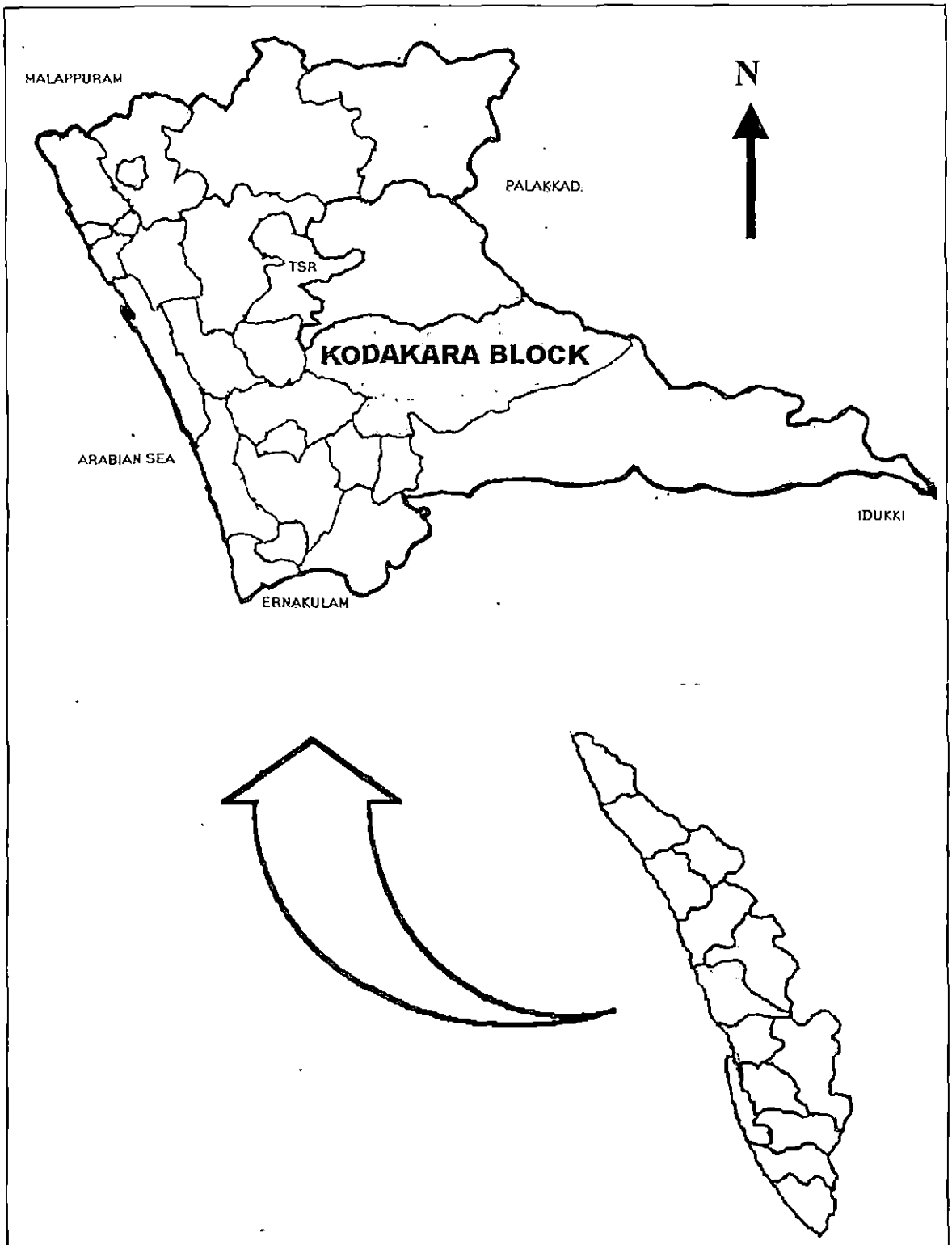

Fig. 3. 1. Map of Kerala showing the study area

panchayaths. Based on the natural physiogrphy, the district is divided in to high land, mid land and low land. The map of the Thrissur district is given in figure 3.1

3.1.2 Land utilisation pattern

The land utilisation pattern in Thrissur district is presented in Table.3.1. Nearly 35 percent of the total area of the district is under forest cover. Almost 66.31 percent of the geographical area is put under cultivation, and nearly 17.03 percent of the area is cropped more than once, with a cropping intensity of 134.56 percent.

Table 3.1 Land Utilisation Pattern in Thrissur district during the year 2000

Description	Area (in ha)	As percentage to the total
Geographical area	299390	100.00
Forest	103619	34.60
Land put to non-agricultural use	32321	10.80
Barren and uncultivable land	494	0.17
Permanent pastures and grazing land	27	0.01
Land under miscellaneous tree crops not included in net area sown	821	0.27
Cultivable waste land	3087	1.03
Fallow other than current fallow	3555	1.19
Current fallow	7936	2.65
Net area sown	147530	49.28
Area sown more than once	50986	17.03
Total cropped area	198516	66.31
Cropping intensity (per cent)	134.56	-

Source: Government of Kerala, 2002

3.1.3 Population

According to the 2001 census report, Thrissur district has a total population of 29.75 lakhs, of this 14.22 lakhs are male and 15.53 lakhs are female. Density of population is 981 persons per square kilometre. The sex ratio of the district indicates that there are 1092 female per 1000 male. The Literacy rate is 92.56 per cent.

The total working population of the district is 804378, of which 74064 are cultivators and 183588 are agricultural labourers. Agriculture provides employment to 32 per cent of the working population and contributes 42 per cent of the total income. Household workers and other workers number 35898 and 511188 respectively.

3.1.4. Climate and Rainfall

Thrissur district experiences warm tropical humid climate. Annual rainfall of 2400.1 mm was received during 2002, of which about 70 per cent was received during south west monsoon season. Average daily maximum temperature was highest (36.2^{0}C) in the month of March and lowest (29.8^{0}C) in the month of July. Rainfall was maximum in the month of June. The monthly average distribution of rainfall for the district during the year 2001 and 2002 is given in Table 3.2. Relative humidity was found to be highest (86 per cent) in June and August and lowest in December (59.00 per cent).

Rubber crop requires a warm humid equable climate (21 ^{0}C to 35 ^{0}C) and fairly distributed annual rainfall of not less than 200 cm. Thus, the climatic conditions and the physiographic features are ideal for the cultivation rubber tree.

Table 3.2 Monthly Average Temperature and Rainfall Distribution in Thrissur District during the Year, 2001 and 2002

Month	Mean max. Temp ^{0}C		Mean Min. Temp ^{0}C		Mean RH (%)		Total Rainfall (mm)	
	2001	2002	2001	2002	2001	2002	2001	2002
January	32.6	32.8	23.2	22.7	56	62	0.00	0.00
February	34.5	34.3	22.9	22.4	67	50	0.00	12.2
March	34.9	36.2	24.0	24.1	69	63	16.2	4.4
April	34.2	35.0	24.7	24.8	75	71	50.8	243.1
May	32.3	32.6	24.5	24.5	81	77	308.4	192.6
June	28.4	30.0	23.1	23.3	87	86	533.5	676.2
July	29	29.8	22.7	23.1	85	84	354	477.7
August	27.5	28.9	23.1	22.9	87	86	506.6	256.2
September	30.8	31.1	23.2	23.0	79	77	124	206.1
October	30.7	30.8	23.0	23.2	81	83	387.7	215.8
November	31.6	31.8	23.1	23.4	72	71	22.1	115.8
December	31.3	32.3	22.2	22.1	60	59	0.00	0.00

Source: Department of Agricultural Meteorology, College of Horticulture, Vellanikkara

3.1.5. Soil

The most predominant soil type in Thrissur district is laterite. But sandy, alluvial and forest soils are also seen in certain belts. The soil type of the study area is of laterite in nature. Forest soil is confined to parts of Thalappilly, Thrissur and Mukundapuram taluks. Alluvial soils, rich in organic matter, are generally seen in the low-lying areas of Thrissur and Mukundapuram taluks. Sandy soil is the major soil type in the coastal areas of Chavakkad taluk.

3.1.6. Water Resources and Irrigation

The district has numerous water resources such as canals, tanks, ponds, wells, tube wells and major and minor lift irrigation projects. Important rivers flowing through the districts are Chalakkudy, Karuvannur and Kecheri rivers. Canoli, Shanmugham and Puthenthode are the three main canals in the district. Bharathapuzha flows westwards at the northern boundary and Periyar flows westwards at the southern boundary. Thrissur district has the highest area under irrigation in Kerala. Major irrigation projects operating in the district are Peechi dam, Mangalam dam, Chimmini dam, Chalakudy Diversification scheme, Vazhani scheme and Chalakudy irrigation project. Source wise irrigated area in the district is presented in Table 3.3.

Table 3.3 Source-wise Irrigated Area in Thrissur District during the Year 2001

Particulars	Irrigated area (in hectares)	Percentage to total
Government canals	17409	20.07
Private canals	107	0.12
Government tanks	569	0.67
Private tanks	10069	11.61
Government wells	539	0.62
Private wells	40570	46.78
Minor lift irrigation	2900	3.34
Other sources	14565	16.79
Total	86728	100.00

Source: Government of Kerala, 2002

It can be seen that private wells form the major source of investigation in the district, followed by the government canals.

3.1.7 Cropping Pattern

The cropping pattern of the district is shown in Table 3.4. Major crops grown in the district are paddy, coconut, arecanut, vegetables, rubber and banana. Rice crop accounts for 21.60 per cent of the total cropped area. Coconut accounts for 44.48 per cent of the total cropped area, and is the main crop in the sandy coastal belt, which stretches over a length of 51.5 km from Kodungallur to Chavakkad. Seasonal crops like tapioca, banana and vegetables are grown in the mid land regions where the soil is laterite in nature. Rubber crop occupies nearly seven per cent of the total cultivated areas.

Table 3.4 Cropping Pattern in Thrissur District during the Year 2000

Crop	Area (ha)	Percentage to total
Paddy	42887	21.60
Pulses	532	0.27
Sugar crops	261	0.13
Black pepper	3861	1.94
Other Spices and condiments	4211	2.12
Arecanut	6355	3.20
Fruits	27233	13.72
Vegetables	1527	0.77
Rubber	13372	6.74
Coconut	88307	44.48
Others	9970	5.02
Total	**198516**	**100.00**

Source: Government of Kerala, 2002

3.2 METHODOLOGY

3.2.1 Type of data

The primary data were collected using a well-structured and pre-tested interview schedule (Appendix I). The secondary data relevant for the study were collected from the Rubber Board Head Office, Rubber Research Institute of India and the Directorate of Economics and Statistic, Government of India.

3.2.2 Sample framework

A list of rubber growers in the various age compositions was prepared and 30 farmers were selected by simple random method.

3.2.3 Period of Study

The primary data pertains to the year 1969-70 to 2000-01. The secondary data pertains to the year from 1960-61 to 2000-01. Data collection was carried out during the period from June 2003 to July 2003.

3.2 TREND ANALYSIS AND ESTIMATION OF GROWTH RATES

Linear, quadratic, cubic, exponential, logarithmic and logistic models were tried for fitting trends of tapped area, production, yield and consumption of natural rubber. The final model was selected based on the adjusted R^2 values, standard error and outlier values (Croxton *et al,* 1988).

For tapped area, production and yield of natural rubber, a growth model as given in equation 3.1 was fitted

$$Y = e^{(a+bt)} \quad \text{----------} \quad 3.1$$

where,

Y = Production or tapped area or yield

t = year

a = constant

b = Regression coefficient

e = 2.718

For the consumption of natural rubber, an exponential model as given in equation 3.2 was used

$$Y = AB^t \quad \text{----------} \quad 3.2$$

Compound growth rates (CGR) of area, tapped area, production and productivity for natural rubber was calculated from the exponential function fitted above. In the exponential function, A and B are given by

A = vertical intercept

B = (1+r),

where "r" is the CGR

The compound growth rate (CGR) was worked out as (Acharya and Madhnani, 1988 and Biradar and Annamalai, 1982):

$$r = (B - 1) \times 100 \quad \text{----------} \quad 3.3$$

3.3 INSTABILITY ANALYSIS

Coefficient of variation (CV), a measure developed by Karl Parson, is the most commonly used measure of relative variation. It is a very useful tool to measure the variability of time series. That series or group for which the CV is greater is said to be more variable or unstable. On the other hand the series for which coefficient of variation is less is said to be more stable or more consistent and more homogeneous (Gupta, 1978)

$$\text{Coefficient of variation (CV)} = \frac{\sigma}{\overline{X}} \times 100 \qquad \text{----------} \qquad 3.4$$

where,

σ is the standard deviation of each individual series and

$\overline{X}$ the arithmetic mean of the each individual series.

3.4 DECOMPOSITION ANALYSIS

Any growth in output can be partitioned into the contributions of changing acreage and changes in yield (Boyce, 1987). Decomposition works in India can be traced to Sastri and Sharma (1959); Sastri (1960) and Sardana *et al* (1966). All the above workers used simple additive model. A major draw back of the additive model is that it is based on the data for the base year and current year only. Moreover, the model gives the weight of current year A_n to yield and changes in area is given the weight of the base year yield Y_0. Narula and Sagar (1973), modified the existing methodology by taking the average weight to the base and current year values. The above methods did not account for the area and yield interaction effects. Increases in production, either contributed by area or yield, result in price changes that influence the future growth in output. This aspect was also overlooked by earlier workers.

Hence, Sharma (1977) developed a decomposition model that estimated the area effect, yield effect, price effect, area-yield interaction effect, area-price interaction effect, yield-price interaction effect and area-yield-price interaction effect. According to him the production in the base year is given by the identity

$$Q_0 = A_0 \times Y_0 \quad \text{----------} \quad 3.5$$

Similarly, production in the n year is given by

$$Q_n = A_n \times Y_n \quad \text{----------} \quad 3.6$$

Also, $Q_n = Q_0+\Delta Q$; $A_n = A_0+\Delta A$; and $Y_n = Y_0 + \Delta Y$

Therefore,

$$(Q_0+ \Delta Q) = (A_0+\Delta A)(Y_0 + \Delta Y)$$

$$\Delta Q = A_0 \Delta Y+ Y_0 \Delta A+ \Delta A \Delta Y \quad \text{----------} \quad 3.7$$

The first term on the right hand side can be considered as the yield effect, the second term as the area effect and the third as the interaction effect. Thus the total change in production can be decomposed in to three effects, viz., yield effect, area effect and the interaction effect due to changes in yield and area.

If we want to decompose total changes in value of production (ΔX), the price effect (p) is also to be measured. For this purpose the equation 3.5 can be rewritten for the base year as $V_0 = A_0 \times Y_0 \times P_0$ and the equation 3.6 can be written for n^{th} year as $V_n = A_n \times Y_n \times P_n$.

Applying the procedure used above we can decompose the total changes in value of production (ΔV) in to seven components *viz.*, yield effect, area effect, price effect, combined area and yield effect, combined price and yield effect, combined price and area effect and combined area, yield and prices effect. The last four components grouped together can be considered as the interaction effect. These

effects in the total change of value of production can be identified by the equation as given in the identity 3.8

$$
\begin{aligned}
\Delta V = {} & P_0 A_0 \Delta Y && \text{-- yield effect} \\
& + P_0 Y_0 \Delta A && \text{-- Area effect} \\
& + A_0 Y_0 \Delta P && \text{-- Price effect} \\
& + P_0 \Delta A \Delta Y \\
& + A_0 \Delta P \Delta Y \\
& + Y_0 \Delta P \Delta A && = \text{Interaction effect} \quad \text{----------} \quad 3.8 \\
& + \Delta A \Delta Y \Delta P
\end{aligned}
$$

Decomposition models based on all the values in the time series were considered superior to additive models. Mohan and George (1993) used a multiplicative model for decomposing the growth in natural rubber production in India. The mathematical derivation is made from the production identity

$$Q_t = A_t \times Y_t \quad \text{----------} \quad 3.9$$

where,

Q_t = Output during the year t

A_t = Area during the year t

Y_t = Yield during the year t

t = Time period

Given the above multiplicative identity, the exponential growth rates of the components on the right hand side sum up to the growth rate on the left-hand side term, output:

$$\text{i.e.} \quad b_Q = b_A + b_Y \quad \text{----------} \quad 3.10$$

where, b_Q, b_A b_Y are the growth rates of output, area and yield respectively and were estimated as:

$$\ln Y_t = a_Q + b_Q{}^t$$
$$\ln A_t = a_A + b_A{}^t$$
$$\ln Y_t = a_Y + b_Y{}^t$$

Now the area effect and the yield effect on the output growth can be estimated by

$$\text{Area effect} = (b_A / b_Q) \times 100$$

Similarly,

$$\text{Yield effect} = (b_Y / b_Q) \times 100$$

The price effect can also be segregated from the output growth, when the identity 3.9 can be modified as

$$V_t = A_t \times Y_t \times P_t \quad \text{----------} \quad 3.11$$

where,

V_t = Value of the output during the year t

A_t = Area under the crop during the year t

Y_t = Yield of crop during the year t and

P_t = Average price of the output during the year t

Given the above multiplicative identity 3.11, the growth in the value of the output can be estimated as:

$$b_V = b_A + b_Y + b_P \quad \text{----------} \quad 3.12$$

where b_V, b_A, b_Y and b_P are the growth rates of value of output, area, yield and the average price respectively and were estimated as:

$$\ln V_t = a_V + b_V^t \quad \text{----------} \quad 3.13$$

$$\ln A_t = a_A + b_A^t \quad \text{----------} \quad 3.14$$

$$\ln Y_t = a_Y + b_Y^t \quad \text{----------} \quad 3.15$$

$$\ln P_t = A_p + b_p^t \quad \text{----------} \quad 3.16$$

The area effect, yield effect and price effect are estimated as follows

$$\text{Area effect} = (b_A / b_V) \times 100 \quad \text{----------} \quad 3.17$$

$$\text{Yield effect} = (b_Y / b_V) \times 100 \quad \text{----------} \quad 3.18$$

$$\text{Price effect} = (b_P / b_V) \times 100 \quad \text{----------} \quad 3.19$$

3.5. CAPITAL PRODUCTIVITY ANALYSIS

Captial productivity analysis is the most important tool for evaluating the financial feasibility of perennial investments. It brings out the efficiency in capital use in production. There are various methods to measure the capital productivity. The four tools of financial feasibility analysis are

1. Pay Back Period (PBP)
2. Benefit Cost Ratio (BCR)
3. Net Present Value (NPV)
4. Internal Rate of Return (IRR)

The cost of cultivation and the returns obtained over the economic life of rubber crop was used for these computations. For estimating these parameters, costs and returns were discounted at 12 per cent rate of interest, which was the prime lending rate for term loans in agriculture

3.5.1 Pay Back Period (PBP)

It measures the efficiency of cultivation by indicating the period within which the net returns offset the capital investment (Gittinger, 1984). The Pay Back Period (PBP) is estimated by deducting the progressive total of costs from the progressive total of returns when the cashflows are irregular. The year at which progressive total of returns exceeds progressive total of costs is considered to be the time period required for a cash flow to recover the capital investments.

3.5.2 Benefit Cost Ratio (BCR)

The Benefit Cost Ratio (BCR) indicates the returns on a rupee of investment. It is the ratio between the present worth of benefits over that of costs (Gittinger, 1984).

It is estimated as:

$$BCR = \frac{\sum_{t=1}^{n} \{B_t / (1+i)^t\}}{\sum_{t=1}^{n} \{C_t / (1+i)^t\}} \quad \text{----------} \quad 3.20$$

where,

n = Total number of years of the project

B_t = Benefits during the year t

C_t = Costs during the year t

i = Discount rate

A project with benefit cost greater than unity is considered financially viable.

3.5.3 Net Present Value (NPV)

This is the most straightforward discounted cash flow measure of the project feasibility. This is simply the sum of the present worth of the net cash flow stream (Gittinger, 1984). In other words, it is the difference between present worth of benefits and present worth of costs.

Net Present Value (NPV) is estimated as :

$$NPV = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+i)^t} \quad \text{----------} \quad 3.21$$

where

n = Total number of years of the project

B_t = Benefits during the year t

C_t = Costs during the year t

i = Discount rate

An investment is considered feasible if the NPV is a positive when discounted at opportunity cost of capital.

3.5.4 Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is the discount rate which makes the net present value of the cash flow equal to zero. This discount rate is termed the Internal Rate of Return (IRR). It denotes the average earning power of the money used in the project over the project life (Gittinger, 1984). An investment is considered feasible as long as the internal rate is above the opportunity cost of capital.

The following assumptions have been made use of while discounting the cash flow generated by the investment.

1. The economic life of the rubber plantation on an average was observed to be 23 years in the study area. Hence, the project life for the cash flow analysis was also reckoned at 23 years.
2. All the calculation for estimating the pay back period (PBP), Benefit Cost Ratio (BCR), Net present value (NPV) and Internal rate of return (IRR) was estimated on per hectare basis. The initial planting density for one hectare was was subsequently thinned down down to 400 plants per hectare till the 12^{th} year. There will loss of trees due to skin diseases, heavy winds and lightnings at the later

stages, which are not replanted. So the plants density by the terminal year would range between 340-350 plants / ha.

3. The salvage value of the capital investment is produced by the timber value of rubber trees after slaughter taping. The matured trees were fetching a timber value of Rs. 350/ tree in the study area during the year 2000-01. Hence the salvage value at the rate of Rs. 350/- tree for timber was brought forward into the cash inflow for the terminal year.

The discounting was carried out at 12 per cent rate of interest, which was the prime lending rate for the agricultural term loans during the study

Internal Rate of Return (IRR) is the that discount rate "i" such that

$$\overline{IRR} = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+i)^t} = 0 \qquad \text{---------- 3.22}$$

where,

n = Total number of years of the project

symbols as explained earlier in 3.21

3.5.5 Calculation of cost of cultivation

Cost of production of any perennial crops is made up of two major components viz., the establishment or overhead cost and the maintenance cost (Das, 1984). The total investment of the initial seven years expenditure have been reduced to an annuity at 12 per cent rate of interest using the formula given by Ayres (1983)

$$A = \frac{1-(1+i)^{-t}}{i} \qquad \text{---------- .3.23}$$

Where,

A = annuity value in rupees

i = rate of interest

t = economic life of the plantation

The total cost of cultivation is estimated as following Das (1984).

Cost of cultivation = Annuity value of the establishment cost
+ average annual maintenance cost ---------- 3.24

Cost of producing one Kilogram of RSS-4 grade rubber sheet was estimated as:

$$\text{Cost of production} = \frac{\text{Cost of cultivation in Rs/ ha}}{\text{Average yield in Kg/ ha}} \quad \text{----------} \quad 3.25$$

3.5.6 Sensitivity analysis

Sensitivity analysis is an analytical technique to test systematically what happens to the earning capacity of an investment if the events differ from the estimate made about them in planning. A sensitivity analysis is done first by identifying variables to which the crop appears to be most sensitive and then varying one element or combination of elements for determining the effect of that change on the measures of feasibility. In agricultural projects, the investments are usually tested for their sensitivity with respect to change in yield, prices and cost escalation. The variables to which the project appears to be most sensitive are listed and alternative scenario are worked out by quantifying the implications on the PBP, NPV, BCR and IRR.

Since in the case of natural rubber production, price was found to be the most sensitive factor, different alternative scenarios were carried out at Rs. 24/ Kg and Rs. 25 / Kg of sheet rubber instead of the average price of Rs. 33/ Kg . Sensitivity

analyses were also carried out with 15 per cent escalation in the operation and maintenance cost and with 15 per cent reduction in the cash inflow.

3.6 COMPARATIVE AND COMPETITIVE ADVANTAGES

A country has comparative advantage in exporting a commodity if the social opportunity cost of producing a unit of the commodity - i. e .the value of all factors production used in their best alternative employment is less than the commodity's export price. Chenery (1961)

3.6.1 Calculation of comparative advantage

Domestic Resource Cost (DRC) Ratio is the most useful indicator that is used to compare the relative efficiency or comparative advantage among agricultural commodities. (Pearson and Meyer, 1974; Appleyard, 1987; Tweeten, 1992; Master and Winter-Nelson, 1995 and Mohanty *et al*, 2002). In the presence of distortions the effective rate of protection is inappropriate and the correct criterion is DRC ratio (Tower, 1984).

DRC Ratio is estimated using the formula given by Pearson and Meyer (1974) as:

$$DRC = [D / (P - F)] > E \qquad \text{----------} \qquad 3.26$$

where,

F = direct and indirect foreign costs per unit of output (in foreign currency)

E = Exchange rate (local currency to foreign currency)

D = Direct and indirect domestic factor costs per unit of output (in local currency)

P = Price of the export per unit (in foreign currency)

The DRC per unit of foreign exchange earned or saved is a measure of comparative advantage. A country has comparative advantage in the production of an exportable commodity if the ratio of the opportunity costs of total (Direct and indirect) domestic factors used in each unit of production to the net foreign exchange generated per unit of the commodity (i.e. the export prices less total foreign factors employed per unit of output) in less than the exchange rate. In other words, a commodity is considered to enjoy comparative advantage as long as:

$$(DRC / E) < 1 \qquad \text{----------} \qquad 3.27$$

3.6.2 Competitive advantage

The theory of international trade must move beyond the comparative advantage to the competitive advantage (Porter, 1990). The idea of competitive advantage is more comprehensive as it involves segmented markets, differential products, technology and differences in economics of scale.

India has a comparative advantage in the production of many crops in terms of diverse agro-climatic regions and the availability of abundant labour. However, these comparative advantages could not be translated in to competitive advantages in the global market because international markets do not operate on comparative advantages alone. International markets are highly competitive, and hence competitive advantages are more important to understand their working (Singh and Babu, 1998). Hence an evaluation of competitive advantages across a commodity and region wise matrix assumes great importance. The export competitiveness of rubber crop in the present study has been calculated using the Nominal Protection Coefficient (NPC).

3.6.3 Nominal Protection Coefficient (NPC)

Nominal protection coefficient is the ratio of the domestic price to the border price (Appleyard,1987; Tweetan,1992; Gulati *et al*; 1994 and Datta,2001). Mathematically, it is estimated as:

$$NPC = P_d / P_b \quad \text{----------} \quad 3.28$$

where,

NPC = Nominal Protection Coefficient of the commodity under consideration

P_d = Domestic price of the commodity

P_b = Border price or reference price the commodity after taking care of transportation and marketing expenses.

The objective of the procedure of calculating the nominal protection coefficient (NPC) is to measure actual divergences or distortions between any given commodity's domestic price and international (border) price. The underlying rationale is that such divergence represents the presence of market interventions such as taxes, subsidies government controlled prices and other policy instruments (Appleyard, 1987).

This coefficient can be calculated either under exportable hypothesis or importable hypothesis depending upon whether the commodity under consideration is an exportable or an importable item. Under the exportable hypothesis, the domestic good competes at a foreign port. Under importable hypothesis, the competition is supposed to be taking place at a domestic port. As natural rubber was is imported regularly and exported under years of surplus production, the analysis was carried out both under exportable hypothesis and importable hypothesis. Under the exportable hypothesis the relevant price is the free on board (f.o.b) price. It is the cost of commodity devoid of the transportation costs -both domestic and international and port clearance charges necessary to take the commodity to the consumer. Under importable hypothesis, the relevant price to be considered is the cost insurance and

freight (c.i.f) price. It is the cost of delivering the commodity to the point of consumption and includes the domestic transport cost and port handling charges. A value of these NPC less than unity confirms import/ export competitiveness, while value of NPC greater than unity confirms absence of competitive strength (Datta, 2001).

3.6.4 Calculation of NPR

The Nominal protection rate (NPR) is the percentage by which the domestic price exceeds the border price (Tweeten, 1992). It is be estimated as:

$$NPR = 100 (NPC - 1) \quad \text{----------} \quad 3.29$$

NPR can also be calculated both under exportable hypothesis and importable hypothesis. The quotas and subsidies and other measures in addition to tariffs can drive a wedge between border and domestic prices. NPR converts such measures to an equivalent measurable tariff rate.

3.7 WTO REGIME AND RELATED ISSUES

At present, WTO is the only international body dealing with the rules of multilateral trade. At its heart are the WTO agreements, negotiated and signed by the bulk of the world trading nations. They are essentially trade contracts, binding governments to keep their trade policies within agreed provisions and limits. The agreements establishing the WTO, hereinafter referred to as "WTO agreements" and its four annexes are furnished in Table 3.5

Table 3.5 Composition of the WTO agreements

Agreements establishing the WTO	
Annex 1. Multilateral Trade Agreements	
I A. Multilateral Agreements on trade in goods.	
Sl.No	Agreements
1	General Agreements on tariffs and trade 1994
2.	Agreement on Agriculture
3.	Agreement on the application of sanitary and phyto-sanitary measures
4.	Agreement on Textiles and clothing
5.	Agreement on Technical barriers to trade
6.	Agreement on Trade related investment measures
7.	Agreement on implementation of article VI of GATT 1994
8.	Agreement on implementation of article VII of GATT 1994
9.	Agreement on Pre-shipment inspection
10	Agreement on rules of origin
11.	Agreement on Import licensing procedures
12.	Agreement on subsidies and countervailing measures
13.	Agreement on safeguards
IB – general Agreement on Trade in services	
IC – Agreement On Trade Related Aspect Of Intellectual Property Aspects (TRIPS)	
Annex 2: Understanding The Rules of and Procedures Governing the Settlements of Disputes.	
Annex 3: Trade policy Review Mechanism	
Annex 4: Plurilateral Trade Agreements	
1.	Agreement on Trade in Civil aircraft
2.	Agreement on Government Procurement
3.	International Diary Agreement
4.	International Bovine Meat Agreement

Source: (Das, 1999 and Joseph and George, 2002)

The WTO agreements and its provisions are more aggressive and mutually reinforcing compared to its predecessor *viz.*, the General Agreements on Tariffs and Trade (GATT), 1948.

At present, natural rubber is categorized as an "industrial raw material" under the WTO agreement and hence provisions related to Agreement on Agriculture (AoA) are not applicable to natural rubber. The provisions of the WTO having a direct bearing on natural rubber cultivation and trade are:

1. Bound rates and applied tariff rates
2. Commitments under the Most Favored Nation (MFN) exceptions
3. Elimination of Quantitative Restrictions (QRs)

4. Safeguard Measures
5. Anti-Dumping Duties
6. Domestic Support and Export Subsidy
7. Non-tariff import restrictions

3.7.1. Bound rates and applied tariff rates

The ceiling rate of import tariff committed by the individual WTO members for each tariff line, normally at six digits level of Harmonized System (HS) of trade classification of commodities is called the bound rate. (GATT, 1994). The product wise bound rates of individual countries are functionally the results of the multilateral trade negotiations. Apart from the broad guidelines and directives, the WTO does not intervene in the fixation of tariff-line-wise bound rates. The bound rates finalized through bilateral negotiations would be multi-laterlised. (Myneni, 2000). As a result, the bound rates are ultimately tariff ceilings offered by the individual countries and these can differ for the same product among different countries. WTO does not impose any universally applicable uniform bound rates for each individual tariff line and the responsibility of a low or high bound rate for a tariff line lies primarily with the concerned members.

The schedules of concessions of bound rate submitted by the members as per Article II of the GATT form an integral part of the WTO agreements under the provisions of the Marrkesh protocol of the GATT, 1994. The schedules shall include base rate of duty (import duty prevailed on 01/09/1986 for agricultural products and 01/01/1990 for other products), bound rate of duty, other duties and charges and details of the Initial Negotiating Rights (INRs), if any granted to any other contracting party for each tariff line during the negotiation (GATT, 1994).

The Government of India (GOI) has adopted different norms in fixing the bound rates for industrial and agricultural products. With regard to the industrial

products, the norm was to fix the bound rate at 40 per cent for those tariff lines for which the base duty (base duty plus other tariffs and charges as on January 1, 1990), was at or above 40 per cent and 25 per cent for the tariff lines with base duty below 40 per cent. The norms for agricultural products have been more liberal with binding tariffs at higher levels at 100 per cent for primary products, 150 per cent for processed products and 300 per cent for edible oils.

3.7.2 Commitments under the Most Favoured Nation (MFN) exceptions

The provisions of the MFN treatment contained in Article I of the GATT, 1994, essentially means non-discriminatory treatments among the members. Any benefit in connection with exporting or importing given to a product of most favored nation (whether a member or not) has to be given to all the members without discrimination. Though this principle runs through the entire structure of multilateral WTO agreements related to goods, it is modified or curtailed by some specific decisions by members (Das, 1999)

The MFN exceptions committed by India are:

4. SARRC Preferential Trade Agreements (SAPTA),
5. Transit and Border Agreements,
6. Indo Sri Lanka Free Trade Agreements,
7. Bangkok Agreements,
8. Global System of Trade Preferences

3.7.3 Elimination of Quantitative Restrictions (QRs)

Quantitative Restrictions (QRs), refer to limit set by the countries to restrict imports or exports in the form of licensing requirements, quotas or canalized trade. Normally under the article XI of the GATT, 1994 a member is not permitted to restrict imports into its territory or exports from its territory. Article XI prohibits QRs on imports or exports. However quantity or value based restrictions are allowed to

safeguard Balance of Payment (BoP) position, under Article XII of the GATT, 1994. Under the Article XX of the GATT, 1994, QRs and other import restrictions measures can be invoked for the protection of public morale, human life, animal life, plant life, national treasures etc or on National security grounds under the Article XXI. No other forms of QRs are allowed.

India had serious BoP crisis in the late eighties and early nineties that even the gold reserve with the Reserve Bank India were pledged with the Bank of England. However, the foreign exchange reserves increased from US $ 9.8 billion in 1993to US $ 25.2 billion by 1995. So the continuation of QRs by India on the BoP ground was questioned in the WTO forum by the United States of America (USA). India offered to withdraw the QRs in a phased manner over a period of six years ending March 31, 2003. But the USA filed a dispute against India in the Dispute Settlement Body (DSB) of the WTO. The DSB under the Article XVI of the understanding of Rules and Procedures Governing the Settlement of Disputes ruled against India. Though the Government of India appealed before the Appellate Body, the findings of the DSB were upheld. Thereafter an agreement was signed between the USA and India under which QRs on the remaining 1429 tariff lines had to be removed before 31st March 2001. (Government of India, 2001). Quantitative Restrictions on 714 items were removed by 31st March 2001. Over 2400 tariff lines were already freed from QRs for imports from SAARC countries with effect from 1998 (Government of India, 2001). It does not mean that India has knocked down the entire QR regime. As of now, India is still maintaining QRs on about 800 items under the Article, XX and XXI of the GATT, 1994. It is important to note that natural rubber is included in the 300 sensitive items to be monitored by the Inter-Ministerial Monitoring Group, viz., "War-Room", constituted by the Government of India (GOI) as a part of the EXIM policy announced on March, 2001 to tackle the consequence of the removal of QRs. (Government of India, 2002)

3.7.4 Safeguard Measures

Safeguard measure (SM) refers to emergency actions, taken temporarily by a member country to provide relief to its domestic industry in the event of facing "serious injury" from a surge of imports. The provisions of the SM were originally contained in the Article XIX of the GATT, 1994. But they are now reinforced in the Agreement on Safeguards (AoS), which forms part of the WTO agreements.

Certain pre-conditions must exist before initiating under Article 2 of the AoS, They are:

(i) Imports of the product under considerations should have increased. There should have been an either an absolute increase or an increase in relation to the domestic production.

(ii) The imports should be in such quantities and under conditions as to cause or threatened to cause serious injury to domestic producers or directly competitive products.

These conditions will be operative without having to be qualified or modified by the relevant provisions of the Article XIX of the GATT, 1994. Serious injury is defined as "a significant overall impairment".

3.7.5 Anti-Dumping Duties

Dumping is defined as the introduction of a product in the commerce of another country at a price, which is less than the normal value (Das, 1999). Some countries export at very low prices to capture markets abroad and to eliminate competition. Hence, dumping is considered to be an unfair practice in the international trade. The low price of the imported product may harm the domestic industry, which is producing like products. Article VI of the GATT, 1994 condemns

dumping and empowers the contracting parties to levy an anti-dumping duty not greater than the defined margin of dumping on any dumped product.

3.7.6 Domestic Support and Export Subsidy

As the Agreement on Agriculture (AoA) does not cover natural rubber, the issue of domestic support is to be examined as per the provisions of Agreement on Subsidies and Countervailing Measures (ASCM). A subsidy is deemed to exist, if there is a financial contributions by the government or if there is income or price support and if this confers a benefit to production or support (Das, 1999).

Two types of subsidies are permissible (Non-actionable). These subsidies are:

(i) Subsidies which are of a general nature. i.e. those subsidies which are not specific to a particular enterprise or industries.

(ii) Subsidies, which though specific, are meant for research, development of disadvantaged regions or environmental purposes.

The subsidy by the Rubber Board for the expansion of Rubber cultivation in the north-eastern states of India is a classical example of the second type of subsidy. One of the main objectives of expansion of rubber cultivation in the North-eastern regions is to wean away the nomadic tribes from the ecological practice of shifting cultivation and to rehabilitate them through scientific cultivation of natural rubber.

Two subsidies are prohibited under the ASCM. They are:

(i) Subsidies contingent on export performance under the Article 3.1(a), i.e. trade distorting subsidies for boosting export

(ii) Subsidies contingent on the use of domestic goods over imported goods under Article 3.1 (b), i.e. import substitution subsidies

Under the special provisions for developing countries, India is exempted from the provisions of export subsidy because the per capita GNP of India is less than US $ 1000 per annum. Therefore, India can continue with the subsidies and introduce new subsidies till the country reaches export competitiveness in natural rubber. A country is deemed to have reached export competitiveness

(i) When a developing country's export of a product has reached a share of 3.25 per cent in the world trade of the commodity

(ii) If such share continues for two consecutive years.

3.7.7. Non-tariff import restrictions

Provisions of the Agreement on Technical Barriers to Trade and Sanitary and Phyto-sanitary measures permit member countries to impose import restrictions for the reasons of security, health and environment. To bring about uniformity in respect of the product regulations and standards and to reduce the possibility of they being used for trade restrictive purposes, governments are encouraged to adopt international standards wherever these are available (Das, 1999).

RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

Keeping in view the objectives of the study, the data collected were subjected to analysis and the results thus obtained are presented under the following nine sections as detailed below:

4.1 Trends in total area, tapped area, production and yield of natural rubber

4.2 Growth rate of total area, tapped area, production and yield of natural rubber in India and Kerala

4.3. GR of production, consumption and export of reclaimed rubber (RR)

4.4 GR in production, import and consumption of synthetic rubber (SR)

4.5 Coefficient of variation in production, consumption, export and import of natural rubber, synthetic rubber and reclaimed rubber (RR)

4.6 Decomposition analysis

4.7 Production Advantage of natural rubber

4.8 Comparative and Competitive Advantage of natural rubber

4.8.1 Computation of Comparative advantage

4.8.2 Computation of competitive advantage under exportable hypothesis

4.8.3 Computation of competitive advantage under importable hypothesis

4.8.4 Computation of NPR

4.9 WTO provisions related to natural rubber

4.9.1 Bound rates and applied tariff rates

4.9.2 Commitments under the MFN exceptions

4.9.3. Elimination of Quantitative Restrictions (QRs)

4.9.4. Safeguard Measures

4.9.5. Anti-Dumping Duties

4.9.6. Domestic Support and Export Subsidy

4.9.7. Non-tariff import restrictions

4.1 TRENDS IN TOTAL AREA, TAPPED AREA, PRODUCTION AND YIELD OF NATURAL RUBBER

An attempt has been made in this section to analyze the growth pattern of natural rubber in Kerala and India with respect to tapped area, production and yield across time. The time series data on tapped area, production, yield and consumption of natural rubber in India during the period from 1960-61 to 1999-2000 have been graphically presented in figures 4.1 to 4.4.

Out of the different functional forms like cubic, logistic, compound, logarithmic and quadratic production functions tried, it was found that a growth model of the following type was found to be the best fit for tapped area, production and yield. For consumption of natural rubber an exponential function turned out to be the best fit

Table 4. 1 Best fitted models with standard errors (SE) and adjusted R^2

Variable	Model	SE of the coefficient	Adjusted R^2 values
Tapped area	$Y = e^{(11.344 + 0.04\,t)}$	0.8001	0.972**
Production	$Y = e^{(10.402 + 0.075\,t)}$	0.1548	0.971**
Yield	$Y = e^{(5.965 + 0.35\,t)}$	0.9013	0.9013**
Consumption	$Y = 44094.4 \times 1.06^{t}$	0.4921	0.996**

** indicates significant at one per cent level

The explanatory variable under consideration explains nearly 98 per cent variation of the dependent variable. All of the regression coefficients were statistically significant at one per cent level.

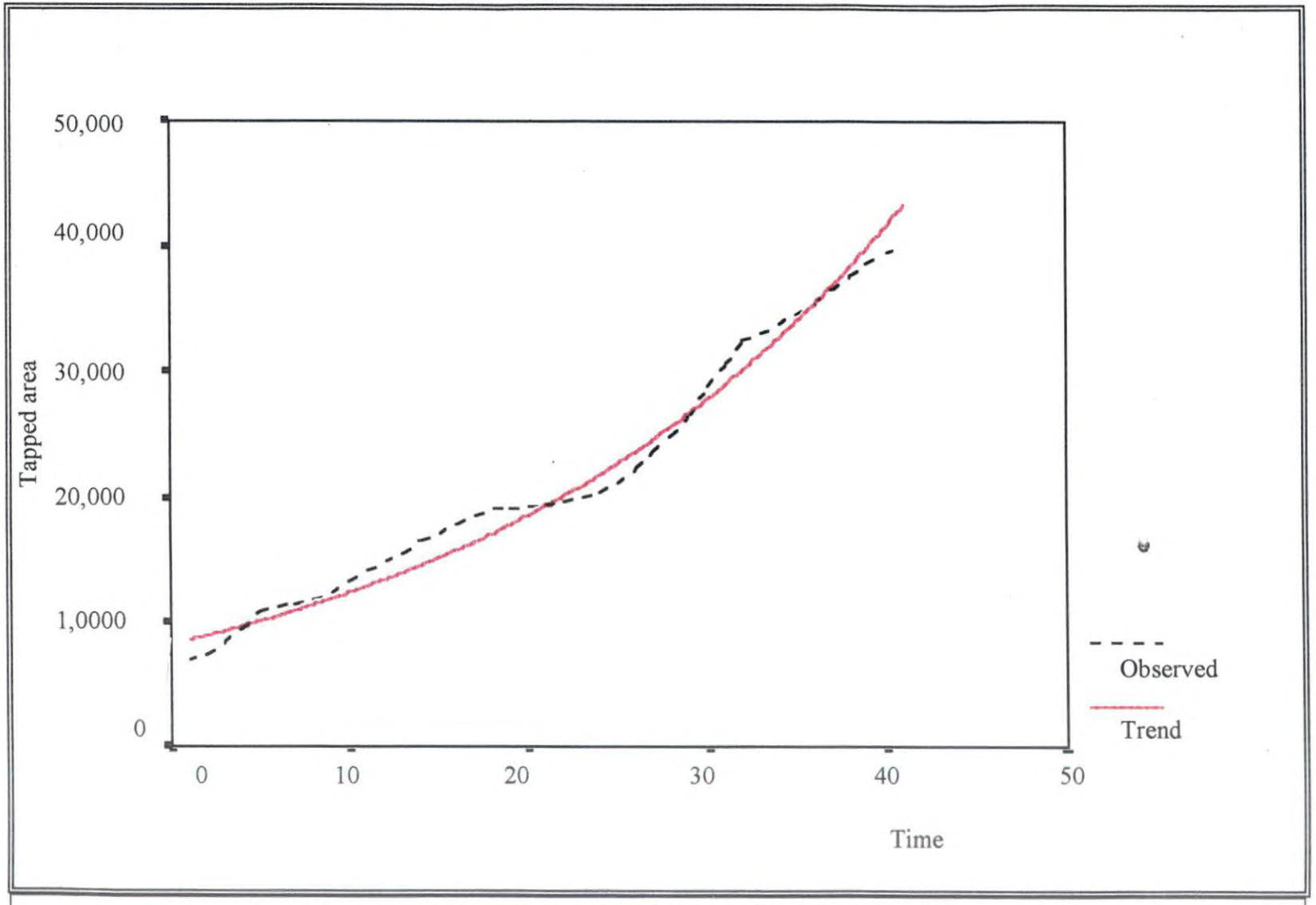

Fig . 4.1 Curve fitting for tapped area of natural rubber in India during 1960-61 to 1999-2000

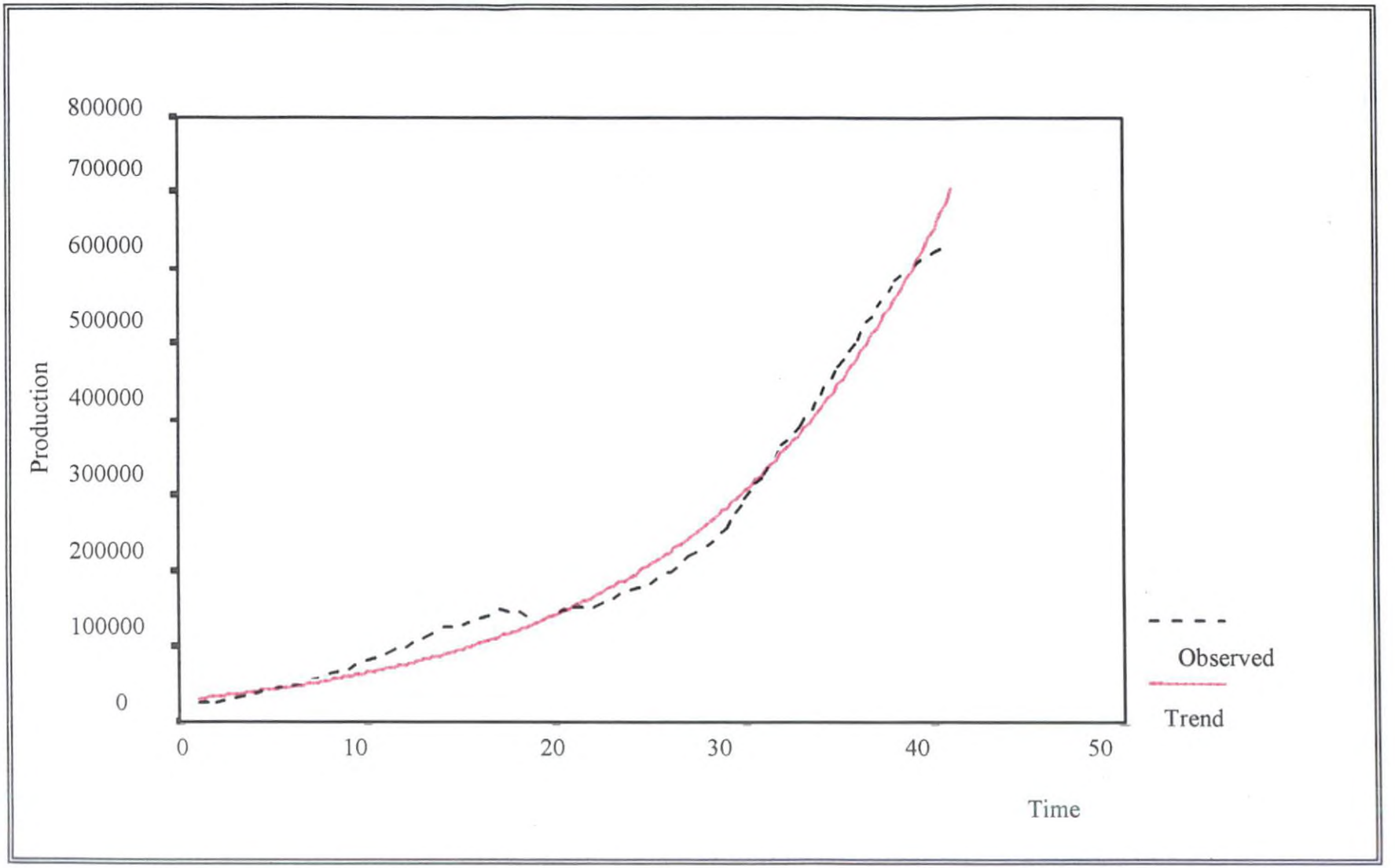

Fig . 4. 2 Curve fitting for production of natural rubber in India during 1960-61 to 1999-2000

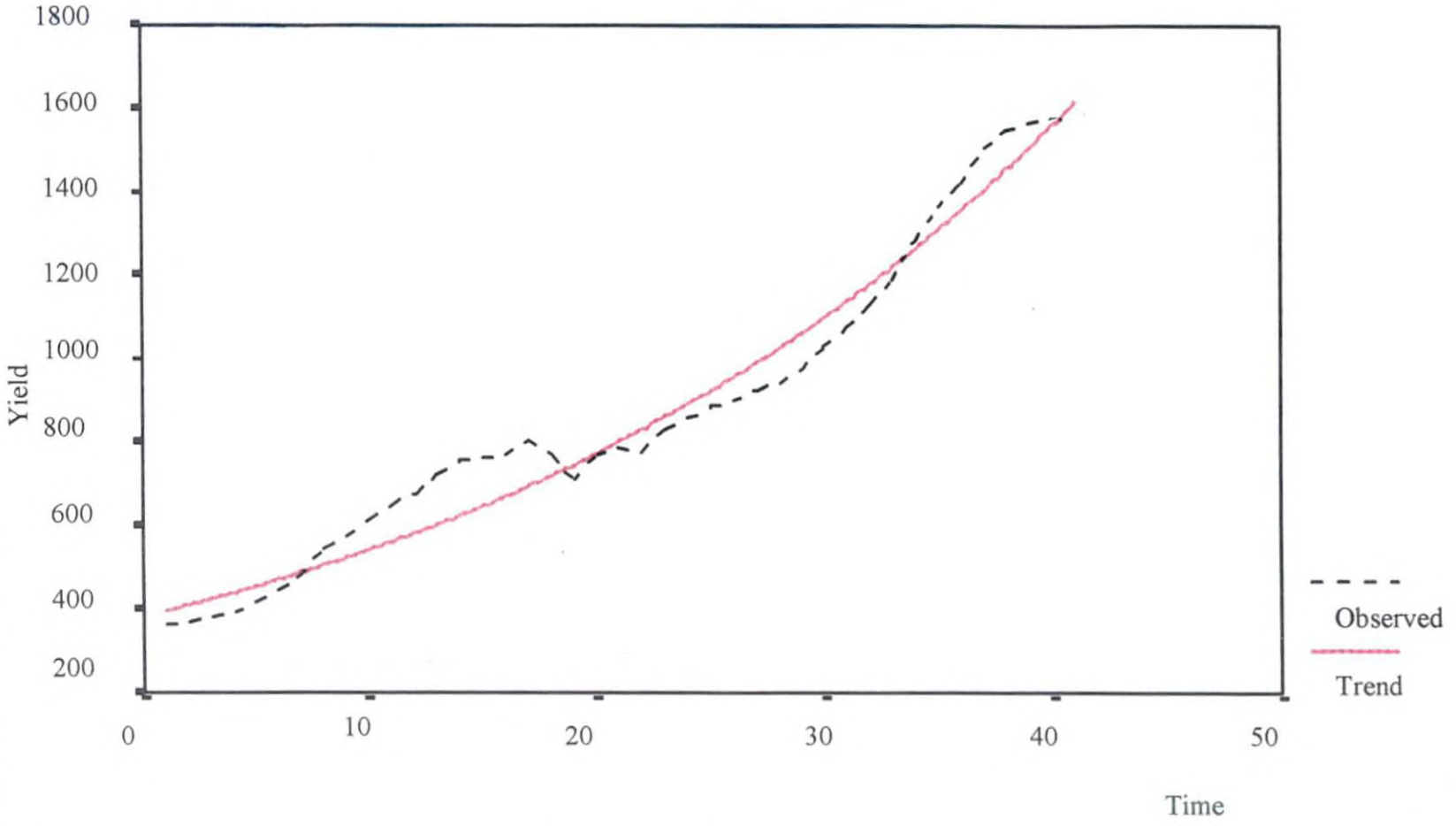

Fig . 4.3 Curve fitting for yield of natural rubber in India during 1999-2000

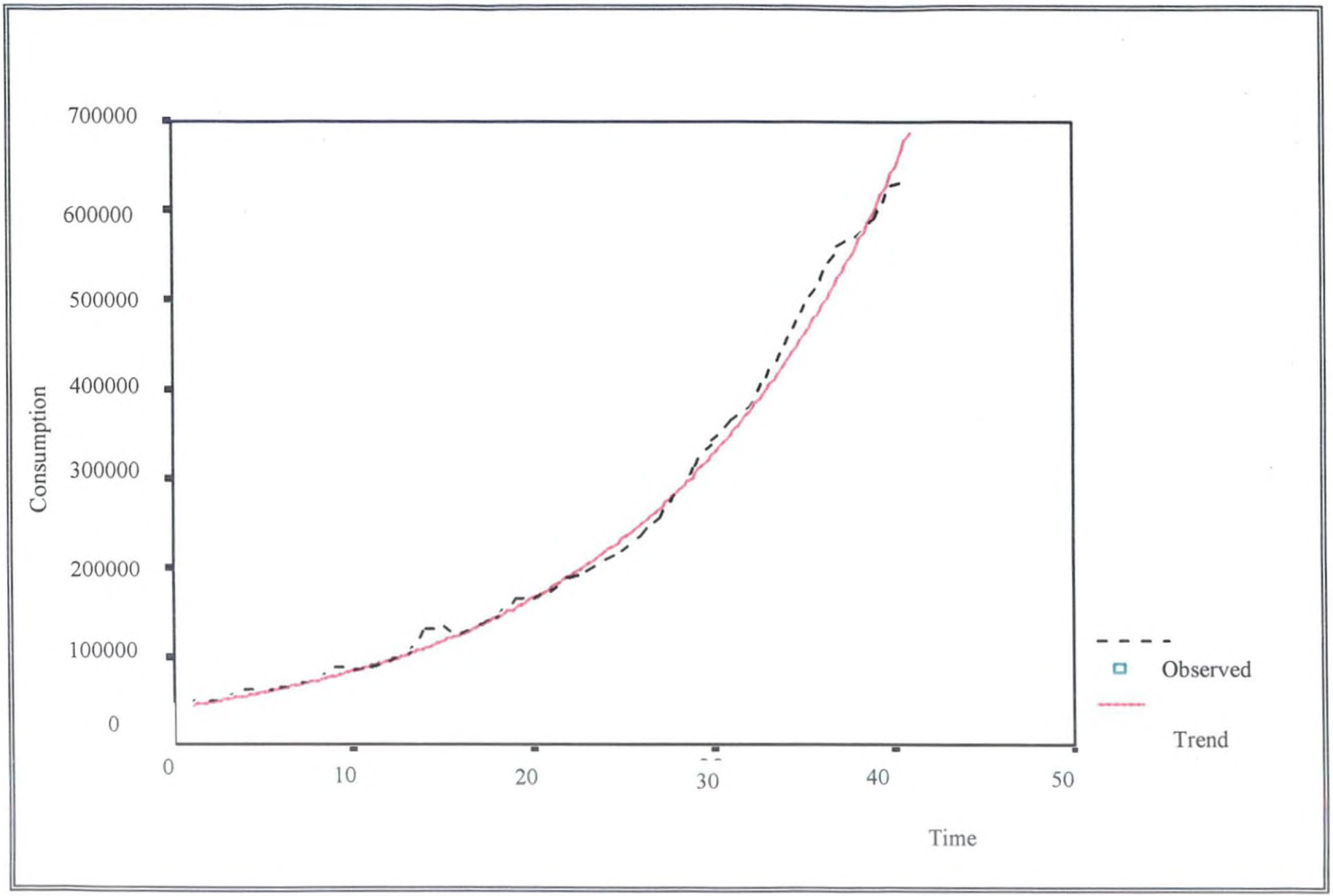

Fig . 4 . 4 Curve fitting for consumption of natural rubber in India during 1960-61 to 1999-2000

4.1.1 Trends in consumption of Natural rubber and Synthetic Rubber (SR)

The relative share of the natural rubber and the synthetic rubber in the total rubber consumption in India is presented in Table 4.2 and figure 4.5. The relative share of natural rubber and synthetic rubber in rubber consumption in India is in the ratio of 71: 19. The remaining 10 per cent of the consumption is contributed by the consumption of reclaimed rubber. It is clear from the Table 4.2 and figure 4.5 that over the years, the trend in consumption of rubber is tilting in favour of natural rubber. This is an advantage for the Indian natural rubber growers. Synthetic rubber consumption, which accounted for 25 per cent of the total rubber consumption in 1970-71, came to about 14 per cent in 1974-75. Subsequently the synthetic rubber consumption increased to 20.60 per cent in 1984-85 but declined thereafter. Currently it accounts for nearly 20 per cent of the total rubber consumption in India. The consumption of natural rubber on the other hand has been consistently on the increase. It increased from 65 per cent of the total rubber consumption in 1970-71 to the current level of 75 per cent. This is in sharp contrast to the international consumption pattern. (Table 4.3 and Fig 4.6).

Table 4.2 Consumption of NR, SR and RR as percentage of total consumption in India

Year	NR consumption (tonnes)	% of NR consumption	% of SR consumption	% of RR consumption
1970-71	87237	64.74	24.61	10.65
1971-72	96454	64.55	24.90	10.55
1972-73	104028	68.17	22.22	9.61
1973-74	130302	75.75	13.91	10.34
1974-75	132604	75.74	13.92	10.34
1975-76	125692	70.82	18.28	10.90
1976-77	137623	74.98	13.60	11.42
1977-78	144967	71.48	17.83	10.69
1978-79	164524	71.13	17.49	11.38
1979-80	165245	70.57	18.47	10.96
1980-81	173630	70.15	19.00	10.85
1981-82	188420	69.98	19.56	10.46
1982-83	195540	69.84	19.73	10.43
1983-84	209480	69.25	20.60	10.15
1984-85	217510	68.50	20.60	10.90
1985-86	237440	68.69	20.26	11.05
1986-87	257305	69.97	19.52	10.51
1987-88	287480	70.98	18.86	10.16
1988-89	313830	71.25	19.11	9.64
1989-90	341840	70.97	19.42	9.61
1990-91	364310	69.85	20.08	10.07
1991-92	380150	70.42	19.57	10.01
1992-93	414105	70.76	18.57	10.67
1993-94	450480	71.84	18.09	10.07
1994-95	485850	72.17	18.23	9.60
1995-96	525465	72.44	18.49	9.07
1996-97	561765	72.85	18.52	8.63
1997-98	571820	71.23	20.04	8.73
1998-99	591545	72.94	19.28	7.78
1999-00	628810	73.16	19.46	7.38
2000-01	631475	73.05	19.75	7.20
	Mean	**70.91**	**19.10**	**9.99**

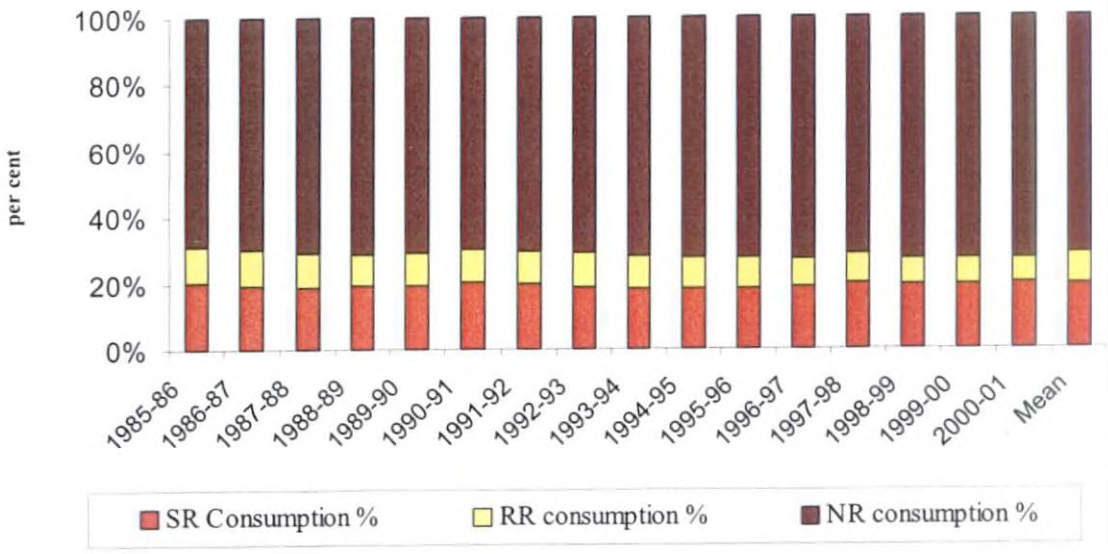

Fig. 4.5 Consumption pattern of NR, SR, and RR in India

The relative share of natural rubber and synthetic rubber in the world rubber consumption on an average is in the ratio of 37:63. (Table 4.3 and fig. 4.6) Since the data on the reclaimed rubber in this regard was not available, it was not included in the present study. It is clear from the Table 4.3 that, though the consumption of synthetic rubber was greater than that of natural rubber in the World's total rubber consumption, there was a declining trend in the consumption of synthetic rubber over the years. Synthetic rubber consumption, which was 67 per cent in the year1985, declined to about 65 percent in 1989. The consumption declined over the years and currently synthetic rubber accounts for about 60 per cent of the world's rubber consumption

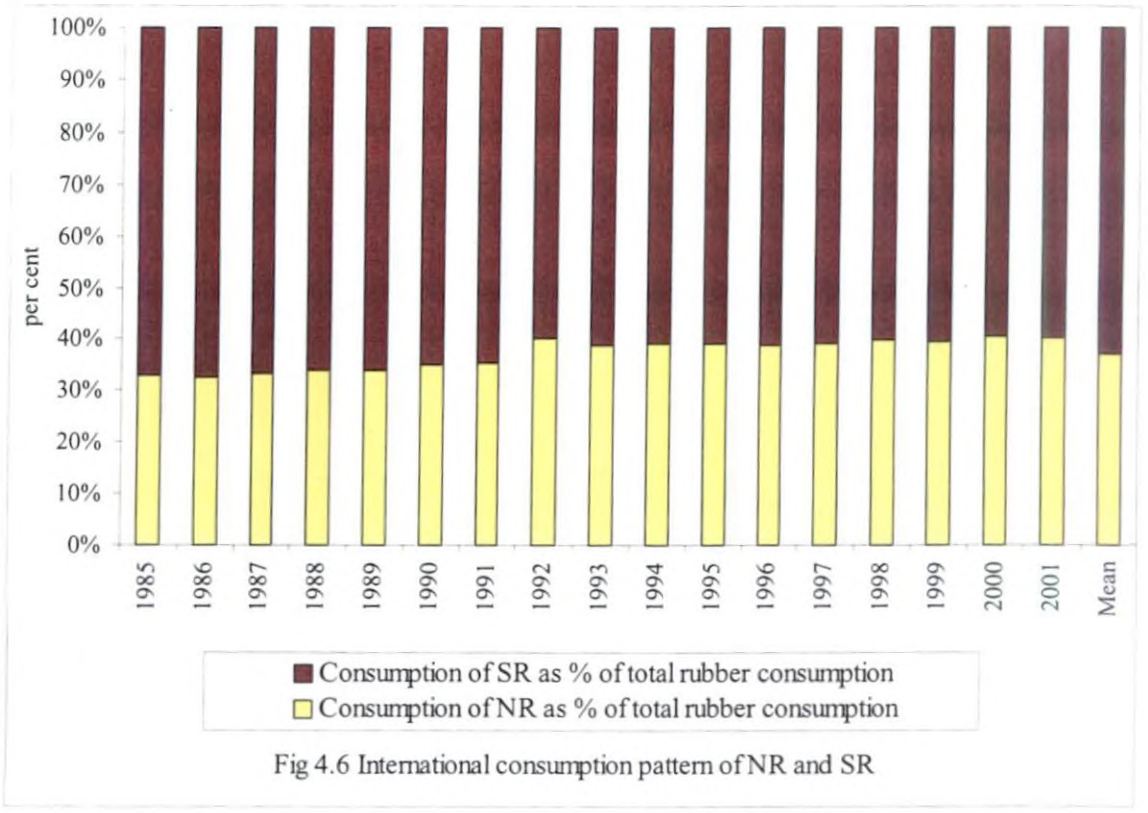

Fig 4.6 International consumption pattern of NR and SR

Table 4. 3 World Consumption of natural rubber and synthetic rubber (SR)

'000 tonnes

Year	Natural rubber consumption	synthetic rubber consumption	Consumption of natural rubber as %	Consumption of SR as %
1985	4430	9000	32.99	67.01
1986	4460	9280	32.46	67.54
1987	4800	9650	33.22	66.78
1988	5100	9940	33.91	66.09
1989	5190	10040	34.08	65.92
1990	5210	9660	35.04	64.96
1991	5060	9220	35.43	64.57
1992	6320	9360	40.31	59.69
1993	5430	8630	38.62	61.38
1994	5650	8820	39.05	60.95
1995	5950	9270	39.09	60.91
1996	6110	9590	38.92	61.08
1997	6460	10000	39.25	60.75
1998	6540	9870	39.85	60.15
1999	6670	10170	39.61	60.39
2000	7330	10810	40.41	59.59
2001	7000	10460	40.09	59.91
		Mean	**37.19**	**62.81**

Though the share of natural rubber in the international consumption of rubber is lesser than the consumption of synthetic rubber, there is an increasing trend in the consumption of natural rubber over the years. In the year 1985, natural rubber consumption accounted for only 33 per cent of the world rubber consumption, However, the consumption of natural rubber increased over the years and currently it accounts for 40 per cent of the total rubber consumption. This tilting of the international consumption pattern in favour of natural rubber consumption can be taken as an opportunity for the future development and expansion of natural rubber market in India.

4.2. GROWTH RATE (GR) OF TOTAL AREA, TAPPED AREA, PRODUCTION AND YIELD OF NATURAL RUBBER IN INDIA AND KERALA

The results of the trend analysis have provided an overview of the changes in respective variables considered. In order to compare the decade wise changes in the variables, their growth rates have been computed. Decade wise compound growth rate (CGR) for total cultivated area, tapped area, production and yield of natural rubber for 40 years from 1960-61 to 1999-2000 for India and Kerala are presented in table 4.4

With respect to India there was an increasing trend during the sixties with regard to the total area (4.47%). The increasing trend decelerated to 1.76 per cent during the seventies. The growth rate in area showed an increasing trend during nineteen eighties. It was 5.54 percent during the eighties.

The results for Kerala were in concordance with the trend shown for all India growth rates. The CGR for sixties for Kerala was 3.57 per cent, which decelerated to 1.82 per cent during seventies. However, similar to all India data in eighties, the growth rate accelerated to 5.14 per cent, which declined to 1.63 per cent during the nineties.

Results for decade wise Compound Growth Rate (CGR) for tapped area for all India during sixties was 7.24 per cent. However the CGR decelerated to

3.66 per cent during the seventies. The eighties showed a moderate increase to 4.53 per cent. During the nineties the CGR was 2.72 per cent.

The results for decade wise Compound Growth Rate (CGR) for tapped area for Kerala was higher than India during the same period. The annual growth rate declined to 3.35 per cent per annum during the seventies. Though in eighties the CGR showed a moderate increase to 4.58 per cent per annum, it decelerated to 2.33 per cent in nineties.

Table 4. 4 CGR for total area, tapped area, production and yield of natural rubber Kerala and India

(Percentage per annum)

	Total area		Tapped area		Production		Yield	
	India	Kerala	India	Kerala	India	Kerala	India	Kerala
(Sixties) 1960-61 to 1969-70	4.47**	3.57**	7.24**	7.50**	14.12**	14.68**	6.42**	6.69**
(Seventies) 1970-71 to 1979-80	1.76**	1.82**	3.66**	3.35**	5.13**	4.87**	1.43*	1.37**
(Eighties) 1980-81 to 1989-90	5.54**	5.14**	4.53**	4.58**	7.65**	7.74**	2.99**	3.01**
(Nineties) 1990-91 to 1999-00	1.78**	1.63**	2.72**	2.33**	7.52**	7.34**	4.67**	4.88**

** Significant 1 per cent level, * Significant 5 per cent level, NS = Non – Significant

The production followed the same trend as that of the tapped area and yield during the sixties. The CGR was 14.12 per cent, which declined to 5.13 per cent during the seventies. The eighties and nineties showed an increase in growth rate. It was 7.65 per cent 7.52 percent respectively.

The CGR values for Kerala with respect to production was in concordance with the all India pattern. Though the CGR values during the sixties was higher than all-India pattern it declined to 4.87 per cent during the seventies. The eighties and nineties showed increase in growth rate to 7.74 per cent and 7.34 per cent respectively.

The decade wise CGR for yield for India during the sixties was 6.42 percent, which showed a declaration during the seventies to 1.43 per cent per annum. The CGR for the eighties however showed an increasing trend to 2.99 per cent. The same increasing trend was visible in the nineties. The CGR during the nineties was 4.67 per cent per annum.

The results for Kerala however showed a CGR of 6.69 per cent during the sixties, which was higher than CGR for yield for India during the same period. The CGR decelerated to 1.37 per cent during the seventies, but showed a moderate increase to 3.01 per cent during the eighties. The CGR for yield was higher than all India pattern for nineties (4.88 %).

The decade wise CGR of consumption of natural rubber was calculated and presented in Table 4.5. The result indicated that the CGR was higher during the sixties, but marginally decelerated to 7.06 in the seventies. However, though the CGR was highest during the decade of eighties, from which the CGR decelerated over the decades to 5.86 in nineties.

Table 4.5 Growth rate in consumption of natural rubber in India

Sl.no	Decade	CGR
1	(Sixties) 1960-61 to 1969-70	7.12
2	(Seventies) 1970-71 to 1979-80	7.06
3	(Eighties) 1980-81 to 1989-90	7.23
4.	(Nineties) 1990-91 to 1999-00	5.86

In order to verify whether the significant growth rates with respect to area, tapped area, and production was contributed by the traditional areas or non traditional areas, GR was calculated separately for these regions. The GR of traditional areas (Kerala, Tamil Nadu and Karnataka) and that of non-traditional areas (North eastern states, Goa, Maharashtra, Andaman and Nicobar Islands etc) are presented in Table 4.6

Table 4. 6 Growth rates of natural rubber in non-traditional areas and traditional areas

(Per cent)

	Non-traditional areas				Traditional areas		
Year	Area	Tapped area	Production	Yield	Tapped area	Production	Yield
1960-61 to 1969-70 **(Sixties)**	-	-	-	-	8.5	14.14	4.27
1970-71 to 1979-80 **(Seventies)**	24.93	40.27	30.34	-7.06	3.63	5.11	2.42
1980-81 to 1989-90 **(Eighties)**	20.96	12.69	20.83	7.21	4.38	7.61	3.55
1990-91 to 1999-00 **(Nineties)**	21.21	21.21	27.6	5.28	2.37	7.29	3.98

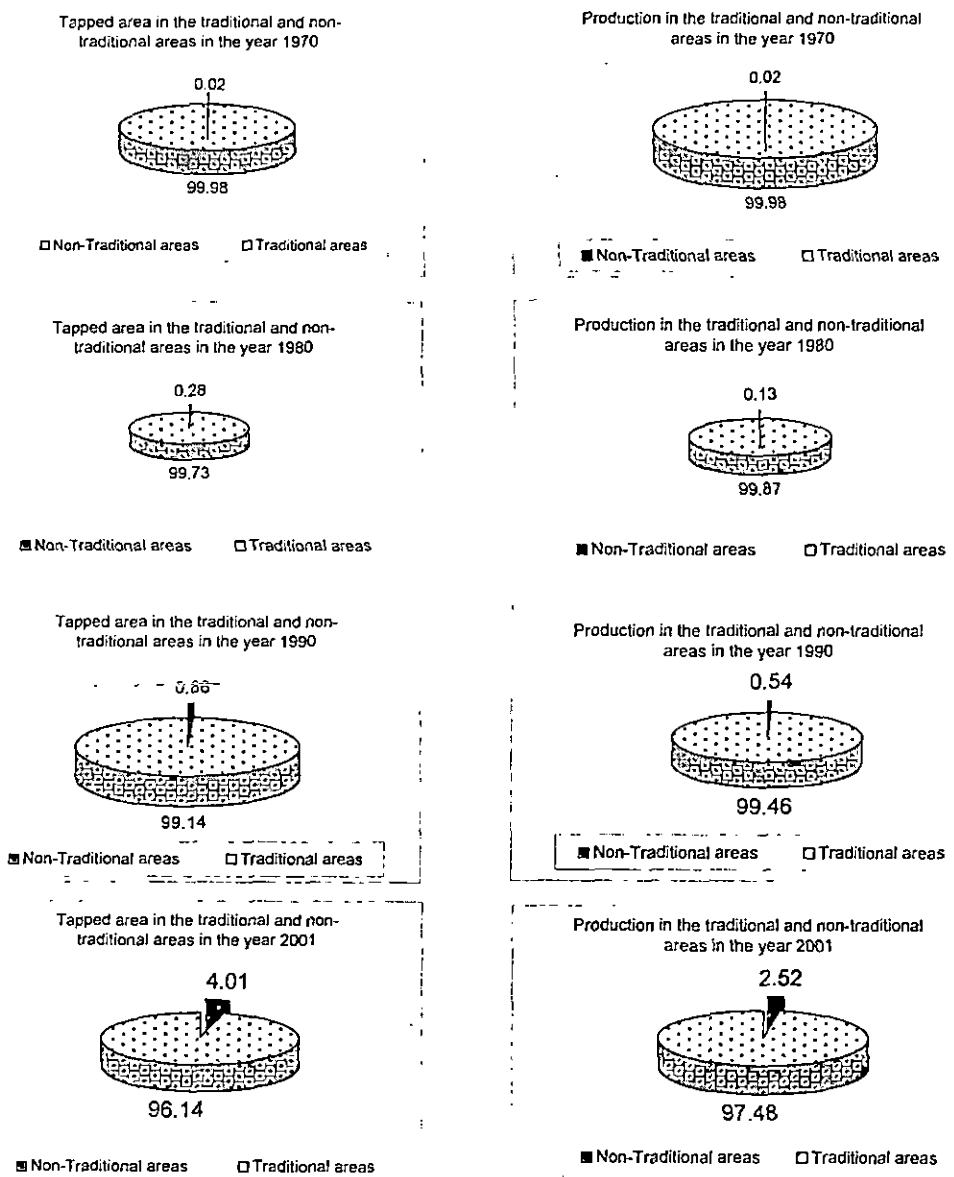

Fig 4.7 Relative contribution of the traditional and non-traditional areas to the total natural rubber production

Though the growth rates are impressive in the non-traditional areas when compared to the traditional areas, a perusal of the Fig. 4. 7 reveals that the contribution of these regions was not significant in the national output. The non-traditional areas experience number of climatic constraints that inhibit the growth of rubber (Figure 4.8). The major production constraints are high altitude, low rainfall, high temperature during summer, negative water balance, cyclones, hailstorms etc.

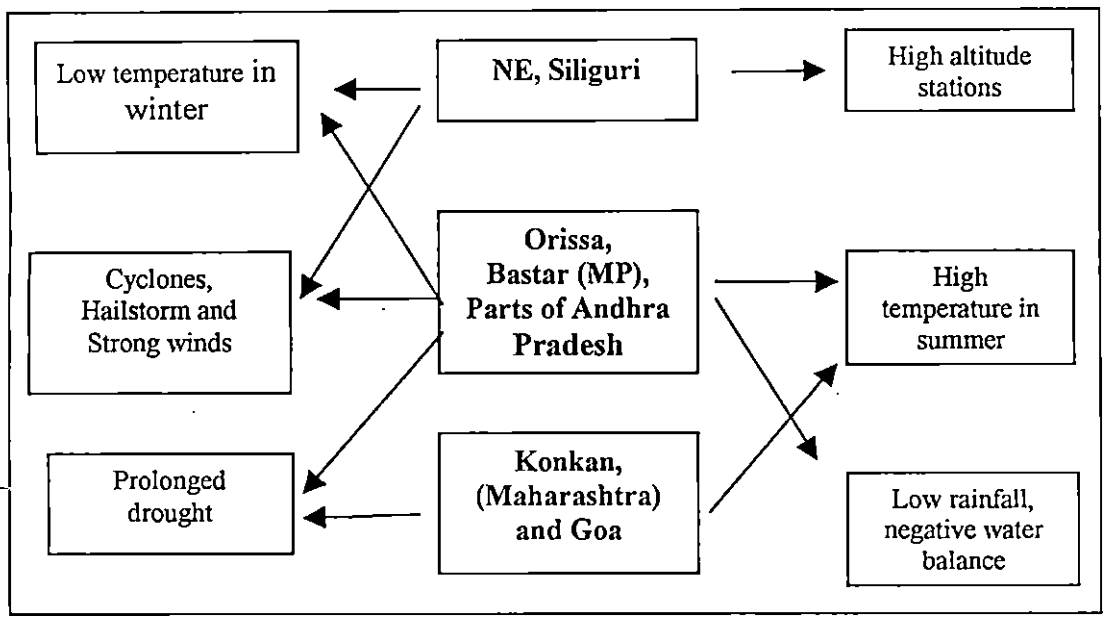

Fig . 4. 8 Climatic constraints in non-traditional areas of rubber cultivation

4.3. GROWTH RATE OF PRODUCTION, EXPORT AND CONSUMPTION OF RECLAIMED RUBBER

The decade wise CGR of the reclaimed rubber, with respect to the production, consumption and exports was calculated and tabulated in Table 4.7. With respect to production, the CGR, values were the highest during seventies. However, it decelerated to 5.78 in eighties and further decelerated to 2.20 in nineties. The consumption too followed the same trend with higher growth rate in the seventies and decelerating over the decades.

There was however difference in the growth rate with respect to exports of reclaimed rubber from the country. The growth rate in exports of reclaimed

rubber was the highest in the decade from nineties. The CGR with respect to export of reclaimed rubber from the country showed a negative growth rate in the eighties (- 7.22).

Table 4.7 Growth rate of production, export and consumption reclaimed rubber

(per cent)

Decade	Production	Consumption	Exports
1970-71 to 1979-80 (Seventies)	6.17	7.10	7.99
1980-81 to 1989-90 (Eighties)	5.78	6.24	- 7.22
1990-91 to 1999-00 (Nineties)	2.20	2.17	16.98

4.4. GROWTH RATE IN PRODUCTION, IMPORT AND CONSUMPTION OF SYNTHETIC RUBBER

Decade wise CGR was calculated for the production, imports and consumption of synthetic rubber from the country (table 4.8). The CGR in the production of synthetic rubber in India was highest in sixties (22.59), however it decelerated rapidly to 0.13 in seventies. Though the CGR increased to 8.62 during the eighties, it decelerated to 2.15 in nineties.

With respect to consumption of synthetic rubber in India, the CGR values were the highest in the sixties. Though it decelerated to 2.27 in the seventies, the CGR values increased to 7.27 in the eighties.

The CGR with respect to imports of synthetic rubber in to the country showed a negative growth rate of – 11.98 in the sixties. However, the CGR values surged up and reached 13.28 in sixties. Though the CGR values decelerated to 7.03 in eighties, it increased to 10.69 in nineties.

Table 4.8 Growth of production, consumption and import of synthetic rubber

(per cent)

Decade	Production	Consumption	Imports
1960-61 to 1969-70 (Sixties)	22.59	17.02	-11.98
1970-71 to 1979-80 (Seventies)	0.13	2.27	13.28
1980-81 to 1989-90 (Eighties)	8.62	7.27	7.03
1990-91 to 1999-00 (Nineties)	2.15	6.05	10.69

4.5. COEFFICIENT OF VARIATION IN PRODUCTION, CONSUMPTION, EXPORT AND IMPORT OF NATURAL RUBBER, SYNTHETIC RUBBER AND RECLAIMED RUBBER (RR)

The Coefficient of variation (CV), indicating the degree of stability of a series of data was calculated for four decades from 1960-61 to 2000-01 and presented Table 4.9

Table 4.9 .Co-efficient of variation for total area, tapped area, production and yield of natural rubber in Kerala and India

(per cent)

Decade	Total area		Tapped area		Production		Yield	
	Kerala	India	Kerala	India	Kerala	India	Kerala	India
1960-61 to 1969-70 (Sixties)	10.61	13.24	21.27	20.61	40.33	38.85	20.79	19.85
1970-71 to 1979-80 (Seventies)	5.69	5.28	10.04	10.86	15.06	15.74	6.58	6.43
1980-81 to 1989-90 (Eighties)	14.94	16.11	14.61	14.33	23.74	23.48	9.11	9.01
1990-91 to 1999-00 (Nineties)	4.92	5.34	6.99	8.12	20.80	21.31	14.29	13.70

With regard to the total cultivated area the instability were the highest during the eighties (16.11 %). During the nineties, the instability decreased to 4.92 per cent and 5.34 per cent respectively for Kerala and India. The CV for the tapped area, for all India data showed a steady decline from 20.61 in the sixties to 8.12 in the nineties. The instability in the tapped area declined constantly over the decades (Table 4.9). The same trend was observable for Kerala also.

Production during the sixties for both Kerala and India was highly unstable as indicated in the Table 4.9. The instability however declined over the decades and reached around 20 per cent. The production was less uniform and unstable during the eighties. Yield instability exhibited a pattern similar to that of tapped area and production both for Kerala and India, with the yield being more unstable during the sixties and progressively declining over the decades. The instability was lowest during the seventies for both Kerala and India. It increased further during nineties.

Table 4.10 **Co-efficient of variation (CV) values for production, import and consumption of Synthetic Rubber**

(Per cent)

Decade	Production	Import	Consumption
1960-61 to 1969-70 **(Sixties)**	40.39	51.48	44.40
1970-71 to 1979-80 **(Seventies)**	17.31	47.77	20.48
1980-81 to 1989-90 **(Eighties)**	26.39	23.26	21.29
1990-91 to 1999-00 **(Nineties)**	10.66	30.54	18.26

The CV for production, import consumption of synthetic rubber (SR) is indicated in Table 4.10. The production of synthetic rubber was highly unstable during the sixties but declined to 17.31 per cent during the next decade. Though the CV declined to 10.66 per cent during the nineties, it showed a higher fluctuation during the eighties (26.39 %). The instability was highest for the import of synthetic rubber during the Sixties and declined over the decades.

The CV for the consumption too followed the same trend as that of production and import. The consumption of synthetic rubber was highly unstable during the sixties (44.40 %), but declined over the decades and reached its minimum of 18.26 per cent during the nineties.

Table 4.11 Co-efficient of variation (CV) values of production, consumption and exports of reclaimed rubber

(per cent)

Decade	Production	Consumption	Exports
1960-61 to 1969-70 **(Sixties)**	-	-	-
1970-71 to 1979-80 **(Seventies)**	19.50	21.67	44.92
1980-81 to 1989-90 **(Eighties)**	17.73	18.85	54.67
1990-91 to 1999-00 **(Nineties)**	8.22	8.64	58.97

The CV for production, consumption and export of reclaimed rubber (RR) are tabulated in the Table 4.11. Due to non-availability of data, CV values were calculated from 1970-71 onwards. The instability with respect to production was the highest for reclaimed rubber during the seventies, but declined progressively. The CV for consumption were highest during the seventies (21.67%). It declined

over the decades. The CV for export of reclaimed rubber was highest during the decade from nineties (58.97 %). The analysis revealed that the instability for export of reclaimed rubber increased progressively over the decades.

4.6. DECOMPOSITION ANALYSIS

An additive as well as a multiplicative model was used to decompose the growth in natural rubber output in India. The additive model, though simple to estimate assumes that increase in crop output is due to absolute additions in acreage or yield or both over the base year. It considers the reference year and the base year values only to account the shifts. The multiplicative model on the other hand, makes use of all the values in the time series to estimate rate of change over the time period. This coefficient represents the proportionate changes and hence it is used to segregate the area, yield and price effects. Decomposition analysis by the additive model is presented in Table 4.12.

In the early seventies, area and yield effect were more pronounced than the price effect. Thereafter, there is a reduction in share of area and yield effect. During this period price has started exerting an increasing influence towards growth of crop output. During the eighties price effect, played a major role towards increase in production than the area and yield effect. As the market is being more exposed to international trends during the eighties and nineties, the area, yield and price interactions effects emerged upper hand than components effects. Rubber is a commercial crop and responds positively to price changes in the short-run as well as in the long-run (Umadevi, 1977 and Ipe and Prabhakaran, 1988)

Table 4.12 Area effect, yield effect and interaction effect in natural rubber production

YEAR	area effect	Yield affect	Price effect	Area and yield effect	price and yield effect	price and area effect	Area, yield, and price effect	% total interactions
1969-70	32.02	30.13	30.85	2.22	2.14	2.46	0.17	7.00
1970-71	47.59	47.33	-0.99	6.36	-0.13	-0.14	-0.02	6.07
1971-72	69.42	62.87	-31.27	12.29	-5.54	-6.60	-1.17	-1.02
1972-73	44.20	48.04	-2.33	11.43	-0.60	-0.60	-0.15	10.08
1973-74	35.06	34.46	11.07	10.96	3.46	3.80	1.19	19.40
1974-75	16.26	14.68	34.80	5.25	11.24	13.43	4.34	34.26
1975-76	21.02	17.25	28.13	7.15	9.57	12.59	4.29	33.60
1976-77	29.19	24.90	16.26	11.65	6.49	8.22	3.28	29.65
1977-78	29.10	19.26	20.20	9.80	6.80	11.10	3.74	31.44
1978-79	18.29	8.51	36.16	4.29	8.47	19.67	4.61	37.04
1979-80	15.27	9.93	33.31	5.17	11.28	18.71	6.34	41.49
1980-81	12.04	8.31	34.90	4.43	12.84	20.09	7.39	44.76
1981-82	10.22	6.58	36.98	3.60	13.03	21.88	7.71	46.22
1982-83	9.90	7.60	33.47	4.36	14.76	20.75	9.15	49.03
1983-84	7.90	6.32	33.19	3.86	16.19	21.87	10.67	52.59
1984-85	8.38	6.88	30.55	4.51	16.44	21.62	11.63	54.20
1985-86	8.49	6.31	28.49	4.74	15.92	23.12	12.93	56.72
1986-87	9.15	6.51	25.48	5.56	15.49	23.52	14.29	58.86
1987-88	8.64	5.84	24.16	5.52	15.43	24.66	15.75	61.36
1988-89	8.71	5.61	21.83	6.02	15.08	25.29	17.47	63.86
1989-90	7.36	4.65	19.62	5.79	15.43	26.39	20.75	68.36
1990-91	7.31	4.61	17.60	6.34	15.28	26.15	22.70	70.48
1991-92	7.14	4.54	15.77	6.87	15.17	25.74	24.76	72.54
1992-93	5.70	3.91	15.21	6.09	16.24	25.56	27.29	75.18
1993-94	5.30	4.03	13.73	6.52	16.91	23.98	29.52	76.93
1994-95	3.54	2.88	13.36	4.83	18.23	24.17	32.98	80.21
1995-96	2.39	2.01	12.90	3.52	18.95	24.40	35.84	82.70
1996-97	2.44	2.15	11.82	3.92	19.03	23.24	37.40	83.59
1997-98	3.30	2.92	10.73	5.57	18.12	22.08	37.29	83.06
1998-99	3.96	3.43	10.07	6.79	17.26	21.55	36.93	82.54
1999-00	3.83	3.26	9.85	6.65	17.09	21.68	37.65	83.07
2000-01	3.93	3.28	9.69	6.82	16.82	21.73	37.73	83.10

The results of the decomposition analysis using the multiplicative model are presented in Table 4.13.

Table 4.13 Area, yield and price effect using multiplicative model

(Per cent)

Decade	Area effect	Yield effect	Price effect
1960-61 to 1969-70 (Sixties)	39.42	34.94	25.64
1970-71 to 1979-80 (Seventies)	25.03	9.78	65.19
1980-81 to 1989-90 (Eighties)	37.5	24.75	37.75
1990-91 to 1999-00 (Nineties)	20.22	34.72	45.06

It revealed that the price effect had a major contribution in accounting the growth in natural rubber production in India. It accounted for 65 per cent of the growth in production during the seventies. During the same period, area effect in production was to the tune of 25 per cent while yield effect had a marginal role of 9.78 per cent. During the eighties, the relative contribution of price came down to 37 per cent, while that of yield increased to nearly 25 per cent. This may be due to the massive expansion in area under natural rubber cultivation in India during this period. The relative contribution of the yield and price towards output growth is around 35 and 45 per cent respectively in the nineties. During this period, area effect came down to 20.22 percentage. This may be due to the launching of Rubber plantation development scheme (RPDS Phase-I) in the country during the 1985 to 1989. Massive new planting and replanting of rubber took place during this period, with a liberal subsidy and institutional finance. So the area effect is more during the eighties. However the newly planted trees may take 7 – 8 years for tapping. During the earlier periods of tapping yield will be low and will become stabilized from the 13^{th} to 17^{th} year, (5^{th} to 10^{th} year of tapping). That is why the yield effect is more pronounced during the nineties.

4.7. PRODUCTION ADVANTAGE OF NATURAL RUBBER

The production advantage was estimated by conducting a financial feasibility analysis as suggested by Gittinger, (1984). The financial feasibility analysis was carried out for the cash flow generated from a cross section survey of 30 farmers in different stages of crop stand. i.e. the farmers were selected such that representative age groups were available. The cash flow analysis included the salvage value (timber value) of the rubber tree at the rate of Rs. 350/ tree at the end of the investment. The cash flow so generated is presented in Table 4.14. The cash flow was estimated at the average price of Rs. 32.28/- per kg of RSS –4 grade sheet rubber (Rubber Board, 2002). The cost of capital taken for analysis is 12 per cent, which is the prime lending rate in the case of term loans during the reference period. The financial feasibility analysis was conducted using the four main criteria *viz.*, Pay Back Period (PBP), Benefit Cost Ratio (BCR), Net Present Value (NPV) and Internal Rate of Return (IRR).

4.7.1.Pay Back Period (PBP)

The investment on the enterprise is said to be feasible if the Pay Back Period (PBP) is less than the economic life of the enterprise. The estimated Pay Back Period is 10.67 years, which was taken approximately as 11 years. Since the Pay Back Period is less than the economic life of the crop *viz.*, 23 years, the crop can be considered to be financially feasible. It is important to note that the rubber crop starts yielding only from the seventh year of planting, hence it is clear that the capital investment made for crop establishment can be recovered within 4 years after the crop starts yielding.

4.7.2.Benefit Cost Ratio (BCR)

The Plantation can be said to financially feasible if the value of the Benefit-Cost Ratio (BCR) is greater than one. The discounted cash flow analysis is presented in the Table 4.14. The results showed that Benefit Cost Ratio is 1.49.

Table 4.14 Discounted cash flow analysis for calculation of PBP, BCR, NPV and IRR

(Per hecatre)

Year	CI	O&M	COF	Total yield	total no of trees	Income from sheet rubber @Rs 32.28/ Kg	Total yield of scrap rubber (kg)	Income from scrap rubber @Rs 24.21 / Kg	Total income (sheet + Scrap) = CIF	CASH FLOW	discounted Cash out flow	discounted.Cash inflow	Discounted Cash flow	unrecovered balance
1978-79	22810.00	4544.30	27354.30	-	400	*0.00*	0.0	0.00	0.00	-27354.30	24423.48	0.00	-24423.48	27354.30
1979-80	4405.00	3987.28	8392.28	-	400	*0.00*	0.0	0.00	0.00	-8392.28	6690.27	0.00	-6690.27	35746.58
1980-81	0.00	3589.30	3589.30	-	400	*0.00*	0.0	0.00	0.00	-3589.30	2554.79	0.00	-2554.79	39335.88
1981-82	0.00	3816.50	3816.50	-	400	*0.00*	0.0	0.00	0.00	-3816.50	2425.45	0.00	-2425.45	43152.38
1982-83	0.00	6072.70	6072.70	-	400	*0.00*	0.0	0.00	0.00	-6072.70	3445.81	0.00	-3445.81	49225.08
1983-84	0.00	7953.76	7953.76	-	400	*0.00*	0.0	0.00	0.00	-7953.76	4029.62	0.00	-4029.62	57178.84
1984-85	33867.43	9746.40	43613.83	*478.00*	400	*15429.84*	38.3	1466.89	16896.73	-26717.10	19728.68	7643.22	-12085.46	83895.94
1985-86	0.00	20391.90	20391.90	*950.00*	400	*30666.00*	75.0	5625.00	36291.00	15899.10	8235.95	14657.33	6421.38	67996.84
1986-87	0.00	21156.90	21156.90	*1050.00*	400	*33894.00*	80.0	6400.00	40294.00	19137.10	7629.39	14530.42	6901.03	48859.74
1987-88	0.00	22606.90	22606.90	*1250.00*	400	*40350.00*	90.0	8100.00	48450.00	25843.10	7278.82	15599.60	8320.79	23016.64
1988-89	0.00	24092.90	24092.90	*1500.00*	400	*48420.00*	100.0	10000.00	58420.00	34327.10	6926.13	16794.35	9868.22	-11310.46
1989-90	0.00	26340.00	26340.00	*1700.00*	400	*54876.00*	110.0	12100.00	66976.00	40636.00	6760.82	17191.07	10430.25	0.67
1990-91	0.00	26744.00	26744.00	*2000.00*	385	*64560.00*	110.7	12251.72	76811.72	50067.72	6129.03	17603.26	11474.23	
1991-92	0.00	27487.00	27487.00	*2400.00*	385	*77472.00*	115.5	13340.25	90812.25	63325.25	5624.38	18581.99	12957.60	
1992-93	0.00	29648.52	29648.52	*2400.00*	385	*77472.00*	120.3	14475.10	91947.10	62298.58	5416.67	16798.39	11381.72	
1993-94	0.00	30117.00	30117.00	*2400.00*	385	*77472.00*	120.3	14475.10	91947.10	61830.10	4912.74	14998.56	10085.83	
1994-95	0.00	30117.00	30117.00	*2200.00*	385	*71016.00*	120.3	14475.10	85491.10	55374.10	4386.37	12451.29	8064.92	
1995-96	0.00	30775.40	30775.40	*2140.00*	350	*69079.20*	113.8	12939.06	82018.26	51242.86	4002.02	10665.62	6663.60	
1996-97	0.00	25393.24	25393.24	*2000.00*	350	*64560.00*	113.8	12939.06	77499.06	52105.82	2948.33	8998.17	6049.84	
1997-98	0.00	29902.05	29902.05	*1755.00*	350	*56651.40*	113.8	12939.06	69590.46	39688.41	3099.85	7214.22	4114.37	
1998-99	0.00	29626.56	29626.56	*1572.00*	350	*50744.16*	113.8	12939.06	63683.22	34056.66	2742.22	5894.49	3152.27	
1999-00	0.00	47766.00	47766.00	*1881.00*	350	*60718.68*	122.5	15006.25	75724.93	27958.93	3947.50	6258.10	2310.60	
2000-01	0.00	53909.47	53909.47	*1720.00*	340	*55521.60*	136.0	18496.00	193017.60	139108.13*	3977.87	14242.37	10264.50	
Total				*29596.00*							147316.22	220122.4	72806.25	

* Includes the salvage value of the rubber tree at the rate of Rs. 350 / tree

NPV = 72806.25	BCR = 1.49	IRR = 20.74 %	PBP = 10.67 years ~= 11 years

CI = Capital Investment, O & M = Operational and maintenance cost, COF = cash outflow, CIF = Cash inflow

It showed that the crop is financially feasible with respect to Benefit Cost Ratio at 12 percent cost of capital.

4.73. Net Present Value (NPV)

The investment on plantation is said to be financially feasible if the value of the Net Present Value (NPV) is found to be positive. The Net Present Value, of the cash flow (Table 4.14) was found to be Rs. 72806/-, at 12 percent cost of capital. Hence, it can be concluded that the investment on the enterprise is financially feasible.

4.7.4.Internal Rate of Return (IRR)

The analysis of the cash flow for (IRR) revealed that IRR was 20.74 per cent, which is greater than the opportunity cost of capital. Hence, the investment on the enterprise is financially feasible with respect to the Internal Rate of Return. Since all the four criteria to appraise the financial feasibility *viz.*, PBP, BCR, NPV and IRR resulted in the PBP being less than the economic life of the crop, the BCR being greater than one, NPV being positive and the IRR being greater than the cost of capital, the investments on rubber is financially feasible.

The cash flow analysis that excluded the salvage value (timber value) of the rubber tree is given in the Annexure II. The resultant cash flow analysis revealed the PBP being 10.67 years (rounded off to 11 years), the BCR being 1.43, the value of the NPV being 64025/- and the value of the IRR being 20.33 per cent. It is clear that even in this cash flow analysis the value of PBP is less than the economic life of the crop (23 years), the value of BCR is greater than one, the value of NPV is positive and the value of the IRR is greater than the cost of the capital. Hence, it is conclusive that the crop is financially feasible with or without the salvage value (timber value) of the tree being included.

4.7.5 Cost of production

The cost of cultivation of sheet rubber of RSS-4 grade was arrived at Rs. 25.48 / Kg. The corresponding price received by the farmer was Rs. 32.28 / Kg. A perusal of the Figure 4. 9 shows that the price of RSS-4 grade rubber sheet during the period from 1992-93 to 2001-02 has not slipped below the present average cost of production. What is remarkable about this is that even during the crisis period of 1998-99 to 2000-01, when the rubber prices recorded depression, the price averaged Rs.30.43/ Kg in the domestic market and Rs.28.45 / Kg in the international market. Hence, it can be concluded that there exits tremendous production advantage for natural rubber for the Indian farmers at the current cost structure and yield levels. The average price of synthetic rubber during the corresponding period was Rs. 54.03 / Kg. (Fig. 4.10) This also provides production advantage because the synthetic rubber is an expensive substitute for natural rubber as of now.

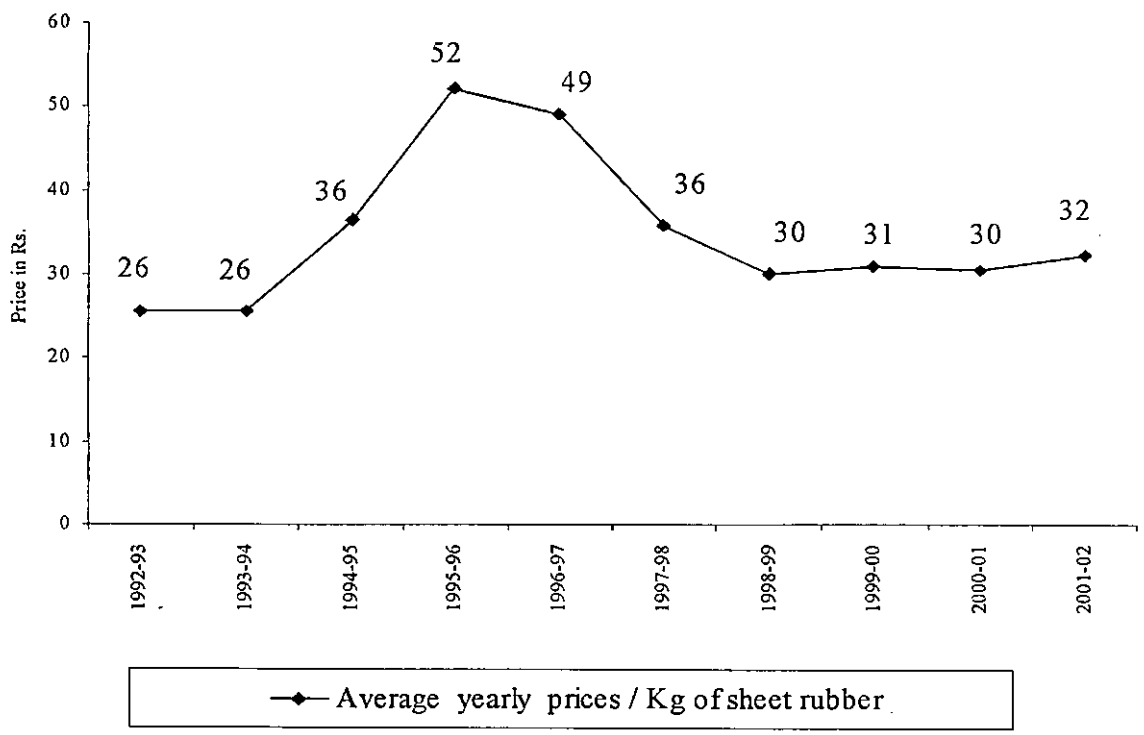

Fig. 4.9 Average yearly prices of NR during the period from 1992-93 to 2001-02

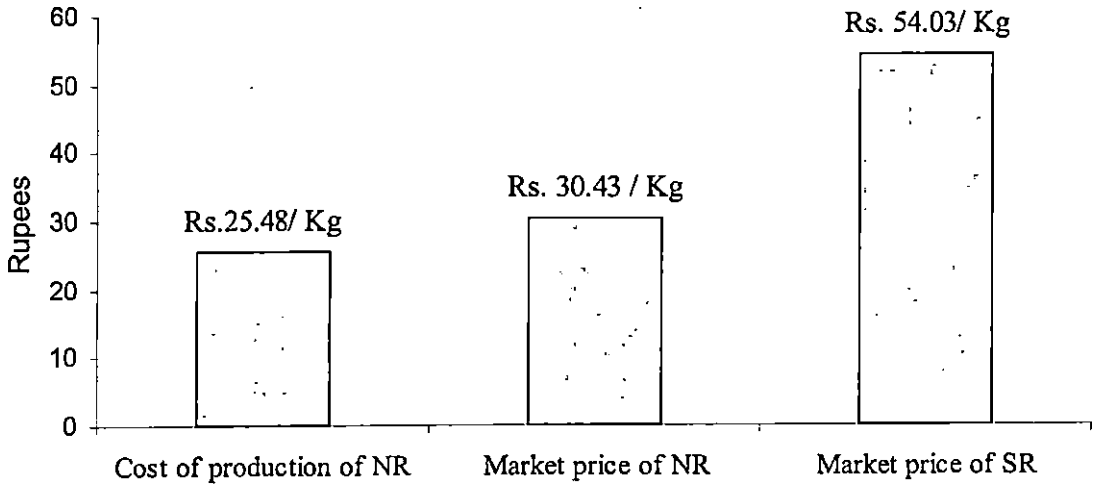

Fig. 4.10 Cost of production and market price of rubber during 2001-02

4.7.6 Sensitivity analysis

Sensitivity analysis was carried out to analyze what happens to the feasibility under three alternative scenarios, viz., a fall in the prices of natural rubber, an increase in the operational and maintenance (O and M) costs by 15 per cent and a reduction in the cash inflow by 15 per cent. The PBP, NPV, BCR and the IRR under the alternate scenarios are presented in Table 4.15 . The sensitivity anlysis that was carried out is given in Appendix III

Table 4.15 Sensitivity analysis of natural rubber under different scenarios

Sl.No	Particulars	PBP (years)	BCR (Ratio)	NPV (Rs.)	IRR (%)
1.	Cost of Rubber sheet at Rs. 24/Kg and scarp rubber cost at Rs.18/ Kg	14	0.99	-912	11.85
2.	Cost of Rubber sheet at Rs. 25/Kg and scarp rubber cost at Rs.18.75/ Kg	14	1.03	4822.18	12.76
3.	Cost of Rubber sheet at Rs. 27/Kg and scarp rubber cost at Rs. 20.25/ Kg	13	1.10	16290.79	14.43
4.	Cost of Rubber sheet at Rs. 29/Kg and scarp rubber cost at Rs. 21.75/ Kg	13	1.18	27759.4	15.99
5.	15 per cent escalation in O & M charges	13	1.18	30350.13	16.10
6.	15 per cent decrease in the cash inflow, other expenses remaining the same	13	1.12	17485	15.10

The sensitivity analysis revealed that only when the cost of rubber sheets when taken as Rs. 24 / Kg and the cost of scrap rubber taken as Rs. 18 / Kg, the returns from the crop was not feasible, because BCR was less than unity, the NPV was negative and the IRR was less than the cost of the capital (12%).

When the cost of sheet rubber was taken at Rs. 25 / Kg and scrap rubber at Rs.18.75 / Kg, the crop turned to be feasible with positive values of NPV (4822.18), BCR greater than unity (1.03) and IRR being greater than the cost of capital (12.76 %). The PBP was less than the economic life of crop (23 years) in both the above cases. The sensitivity analysis carried out with 15 per cent escalation in O and M costs revealed that the BCR was greater than unity, IRR was greater than the cost of capital (16.10 %), the NPV was positive (30350) and the PBP was less than the project life.

The sensitivity analysis with 15 per cent reduction in the cash inflow by keeping all other cost, returns and yield as same revealed that BCR was greater than one (1.12), the NPV values was positive, the IRR values was greater than the cost of capital. The PBP though increased from 11 years (before making the reduction) to 13 years after making the reduction in cash inflow, was still lesser than the economic life of the crop.

Hence it could be concluded that natural rubber production is much more price sensitive than the other cost and returns factors. A crash in the prices of natural rubber is expected to affect the natural rubber growers for greater than cost than escalation or a systematic reduction in the inflow the reduction in the inflow.

4.8 TRADE COMPETITIVE ADVANTAGE OF NATURAL RUBBER

4.8.1 Computation of Comparative advantage

The results of the DRC analysis are presented in Table 4.16 For calculating DRC ratio, the cost of production that was already arrived and reported in the section 4 .7.5. was used. The same reference period (i .e. from the

Table 4.16. Year wise domestic and border price (c.i.f) of natural rubber

YEAR	Domestic price of RSS 4 Rs / Quintal	CIF equivalent in Indian Rs / Quintal
1979-80	1035.00	1072.00
1980-81	1241.00	1170.00
1981-82	1460.00	938.00
1982-83	1440.00	819.00
1983-84	1752.00	1120.00
1984-85	1665.00	1110.00
1985-86	1732.00	980.00
1986-87	1660.00	1057.00
1987-88	1792.00	1321.00
1988-89	1815.00	1717.00
1989-90	2131.00	1623.00
1990-91	2129.00	1604.00
1991-92	2141.00	2000.00
1992-93	2550.00	2655.00
1993-94	2569.00	2786.00
1994-95	3638.00	3779.00
1995-96	5204.00	5375.00
1996-97	4901.00	5143.00
1997-98	3580.00	3776.00
1998-99	2994.00	3127.00
1999-00	3099.00	2689.00
2000-01	3036.00	3296.00
2001-02	3228.00	3041.00
mean	**2469.22**	**2269.48**

Source : Rubber Board, 2002

Cost of production per Kg of sheet rubber = Rs . 25.48

$$\text{Domestic resource cost ratio} = \frac{\text{Cost of production}}{\text{Border price equivalent in domestic currency}}$$

$$= 1.12$$

period from 1979-80 to 2001-02) was used to study the comparative and competitive advantages. The cost of production was Rs 25.48 / Kg of RSS-4 grade sheet rubber. The average c. i.f. price for the corresponding period from 1979-80 to 2001-02 was Rs. 22.69 / Kg of rubber. It can be seen that the DRC ratio for the reporting period is 1.12. (Table 4.16) Since the value of DRC ratio is greater than unity, it is apparent that India does not have comparative advantage in producing natural rubber at the existing cost-return and yield level for international trade. However, it can be treated as a border line case because the DRC ratio was close to unity. A slight improvement in productivity or change in global prices can turn the tables in India's favour.

4.8.2 Computation of Competitive advantage under exportable hypothesis

NPC can be estimated both under exportable hypothesis and importable hypothesis as indicated in section 3. 6.3 . In this section an attempt has been made to assess the trade competitive advantage of natural rubber as an exportable commodity. For calculating NPC under the exportable hypothesis, the f.o.b price is taken into consideration as the relevant border price. The average f.o.b price for 23 years from 1979-80 to 2001-02 was arrived at Rs. 21.00 / Kg. The value of NPC under the exportable hypothesis was estimated to be 1.18 (Table 4.17). It indicated that under the exportable hypothesis, natural rubber production and trade in India was not in an advantageous position at the existing levels of yield and cost return structure. An examination of the year wise NPC values under exportable hypothesis for the years from 1979-80 to 2001-02 indicated that natural rubber was not export competitive for the entire period, except for the year 1997-98. However even for this particular year, the trade competitiveness can be considered as only marginal as the value of NPC for this particular year was very close to unity (0.99) which can be considered as a borderline case.

Table 4.17 Calculation of NPC under exportable and importable hypothesis

YEAR	Domestic price of RSS 4 Rs./quintal	c.i.f price (equivalent in Indian Rs) /quintal	f.o.b price (equivalent in Indian Rs)/ quintal	NPC under the exportable hypothesis	NPC under the importable hypothesis
1979-80	1035.00	1072.00	1011.00	1.02	0.97
1980-81	1241.00	1170.00	1083.00	1.15	1.06
1981-82	1460.00	938.00	872.00	1.67	1.56
1982-83	1440.00	819.00	739.00	1.95	1.76
1983-84	1752.00	1120.00	1042.00	1.68	1.56
1984-85	1665.00	1110.00	1040.00	1.60	1.50
1985-86	1732.00	980.00	890.00	1.95	1.77
1986-87	1660.00	1057.00	988.00	1.68	1.57
1987-88	1792.00	1321.00	1217.00	1.47	1.36
1988-89	1815.00	1717.00	1600.00	1.13	1.06
1989-90	2131.00	1623.00	1482.00	1.44	1.31
1990-91	2129.00	1604.00	1425.00	1.49	1.33
1991-92	2141.00	2000.00	1796.00	1.19	1.07
1992-93	2550.00	2655.00	2457.00	1.04	0.96
1993-94	2569.00	2786.00	2538.00	1.01	0.92
1994-95	3638.00	3779.00	3455.00	1.05	0.96
1995-96	5204.00	5375.00	5030.00	1.03	0.97
1996-97	4901.00	5143.00	4764.00	1.03	0.95
1997-98	3580.00	3776.00	3614.00	0.99	0.95
1998-99	2994.00	3127.00	2884.00	1.04	0.96
1999-00	3099.00	2689.00	2644.00	1.17	1.15
2000-01	3036.00	3296.00	3007.00	1.01	0.92
2001-02	3228.00	3041.00	2732.00	1.18	1.06
Mean	**2469.22**	**2269.48**	**2100.43**		

NPC under exportable hypothesis $= \frac{24.69}{21.00}$

$= 1.176 \sim = 1.18$

NPC under importable hypothesis $= \frac{24.69}{22.69}$

$= 1.088 \sim = 1.09$

Though import may appear cheaper under the circumstances, the import of natural rubber is currently restricted through two designated ports, *viz.*, Vishakapattinam and Kolkota. The selectivity of ports and the cost of transportation will nullify the difference in price now. The possibility of 'surge in imports' of natural rubber to an extent of substitution to domestically produced natural rubber is possible only if the import is permitted through ports of choice.

4.8.3 Computation of competitive advantage under importable hypothesis

As natural rubber has been imported in India in all the years from 1985-86 to 2001-02, its competitiveness under the importable hypothesis is also analyzed. For calculating NPC under the importable hypothesis, the c.i.f price is taken as the relevant border price. The average domestic price of RSS-4 grade of natural rubber for 23 years from 1979-80 to 2001-02 was Rs. 24.69 / Kg. The value of NPC under importable hypothesis was calculated to be 1.09 (Table 4.17). It is clear that under importable hypothesis, the value of NPC is greater than one, indicating that the domestic natural rubber is not enjoying trade competitive advantage at the existing levels of domestic and international price. In other words, imported rubber is cheaper than domestically produced rubber.

An examination of the year wise NPC under the importable hypotheses for the period from 1979-80 to 2001-02 indicated that natural rubber enjoyed trade competitive advantage for a brief period from 1992-93 to 1998-99, when the NPC was less than unity. However, the crop lost its competitive advantage from 1998-99 onwards.

A major factor contributing to lack of competitiveness is the higher domestic price in relation to the international price. (Figure 4. 11). It can be seen that the domestic price of natural rubber remained divergent from the international prices during the eighties. In the nineties the domestic price is more convergent with the international price though it is still higher than the international price

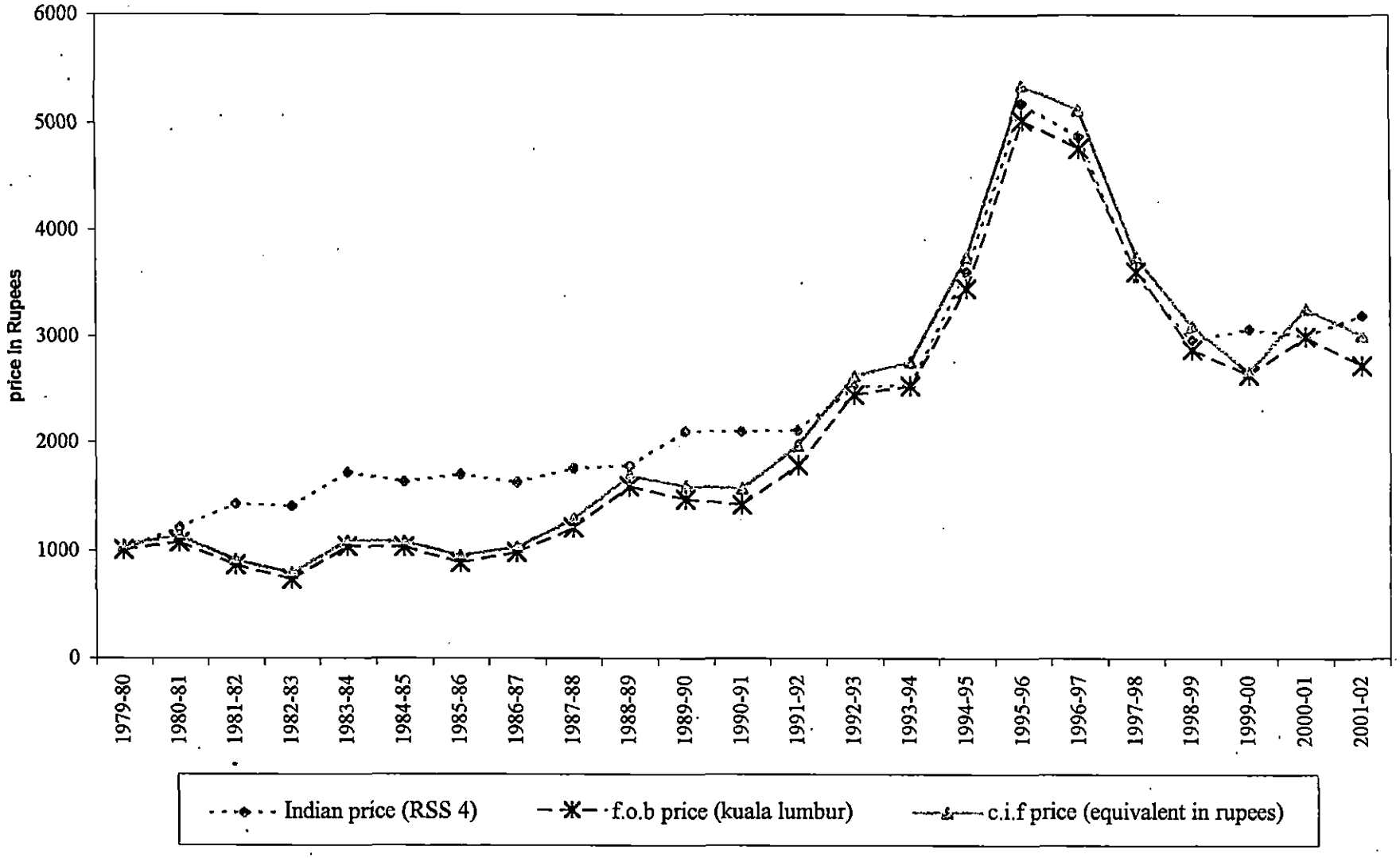

Fig 4.11 Domestic, f.o.b and c.i.f price of NR during the 23 years from 1979-80 to 2001-02

4. 8.4 Calculation of Nominal Protection Rate (NPR)

NPR was calculated under the exportable hypothesis as shown below. The NPR is estimated as follows

$$NPR = 100(NPC - 1)$$
$$= 100\ (1.18 - 1)$$
$$= 18 \text{ per cent}$$

The NPR estimated was 18 per cent. It indicated that the domestic price of natural rubber on an average remained 18 per cent higher than the f.o.b. price of natural rubber. This is in conformity with the earlier findings with the NPC values.

The calculations of NPR under the importable hypothesis was also carried out as shown below:

$$NPR = 100\ (NPC - 1)$$
$$= 100\ (1.09 - 1)$$
$$= 9 \text{ per cent}$$

It indicated that during the period from 1979-80 to 2001-02, the domestic price of natural rubber on an average, remained 9 per cent higher than the import (c .i. f) price. This was also conforming the earlier findings using the NPC value. It can thus be concluded that Indian natural rubber is not enjoying trade competitiveness internationally at the current levels of cost, yield and price structure.

4.9. WORLD TRADE ORGANIZATION (WTO) TO PROVISIONS RELATED TO NATURAL RUBBER

4.9.1 Bound rates and applied tariff rates

The commitment of bound rates submitted by India for tariff lines falls under Chapter 40 of the Harmonized system (HS) (dealing with rubber and rubber products). Dry form of natural rubber covering sheet rubber (RSS), technically specified rubber (TSR) and other dry forms of processed rubber are bound at 25 per cent and natural rubber latex was kept unbound. Different forms of synthetic rubber and reclaimed rubber were kept at 40 per cent. Intermediate

and minor rubber products with HS codes from 4004 to 4009 were bound at 40 per cent, where as major rubber products with HS codes from 4010 to 4017 like tyres and tubes were kept unbound. This is inconsistent with the items coming under other plantation crops, which are classified as agricultural products, and a higher bound rates fixed. It means that while import duties of many agricultural products could be raised to protect the domestic market, while that of rubber could not be done so as it was fixed at 25 per cent. The only alternative to overcome this problem is to demand the reclassification of natural rubber as an agricultural commodity by the producing countries so that they can demand renegotiations under the Article XXVIII of the GATT, 1994 to modify the committed bound rate. The Government of India tried this issue in the Doha round Ministerial Conference, but without success. This is on account of conflicting national interests. Major natural rubber producing countries like Malaysia are having low bound rates of five per cent for natural rubber. This suits their interests as Malaysia has been importing unprocessed rubber in bulk for processing. Other producers like Sri Lanka, China and Thailand have all the processed forms of rubber unbound. (ANRPC, 2001). As the consumption of natural rubber in China is around 185 per cent of its production, they want their market open for massive imports of raw rubber. For India, since the gap between the natural rubber production and consumption is relatively narrow, the domestic market is highly sensitive to the volume and time of imports.

The implications of fixing import tariffs of natural rubber latex as unbound, is expected to have a minimal impact on the domestic natural rubber market as the share of the latex import constitutes only 6.9 per cent of the total natural rubber imports by India during the 1990-91 to 1999-00 period (Rubber Board, 2000). Dry forms of natural rubber such as RSS sheet, Technically Specified Rubber (TSR) and crepe rubber have been dominating the natural rubber production and consumption in India with relative share of around 90 per cent.

4.9.2 Commitments under the Most Favored Nation (MFN) exceptions

The applied rates of tariffs for rubber and major rubber products in India applicable now are furnished in Table 4. 18

Table 4. 18 Applied rates of duties for rubber and rubber products in India during 2001-02.

(per cent)

Sl. No	Type of the product	Applied rates of duty			
		Basic	Additional	Special Additional duty	Total
1.	NR latex whether or not vulcanized	35	0	4	39
2.	Smoked sheets	25	0	4	29
3.	Technically specified NR	25	0	4	29
4.	Other forms of NR	25	0	4	29
5.	Synthetic Rubber in all forms	35	16	4	55
6.	Reclaimed rubber in all forms	35	16	4	55
7.	New pneumatic tyres of rubber used in cars	35	32	4	71
8.	New pneumatic tyres of rubber used in buses and lorries	35	32	4	71
9.	New pneumatic tyres of rubber used on aircraft	25	32	4	61
10.	New pneumatic tyres of rubber used on motor cycles	35	32	4	71
11.	New pneumatic tyres of rubber used on bicycles	35	0	4	39

(Goyal, 2001)

With this tariff structure, the price advantage between imported natural rubber and domestically produced rubber are marginal as is evident from Table 4. 19.

Table 4. 19 Comparative costs of imported and locally procured natural rubber

(Rs. / Kg)

Sl. No	Cost components	NR price under OGL import	Domestic Production price	Import from Sri Lanka
1.	Price	30.41	32.28	30.41
2.	Basic Duty	10.64	0.00	6.08*
3.	Special additional duties	1.22	1.29	1.22
4.	Cess	1.50	1.50	1.50
5.	Purchase tax	0.00	3.71	0.00
6.	Additional sales tax on purchase tax	0.00	4.84**	0.00
	Total cost	**43.77**	**43.62**	**39.21**

** at the rate of 15 per cent

* 20 per cent as under the Indo Sri Lanka Free Trade Agreement

It may be noted that with present tariff regime, the margin of cost between domestically produced rubber and imported rubber under the OGL is just Re. 0.15 / Kg. Any increase in the domestic price can upset this equilibrium, whereby imported rubber becomes cheaper. It is because of this price sensitivity that natural rubber is now classified as a "sensitive item" to be monitored by the Inter-Ministerial Monitoring Group *viz.*, the " War Room". Three hundred such items are monitored by the war room currently, which includes commodities like cotton, tea, coffee and spices.

Imports from Sri Lanka under the Indo-Sri Lanka Free Trade Agreement continue to be cheaper because of concession of 20 per cent instead of the MFN duty of 25 per cent. It is to be noted that the cost of locally produced domestic

rubber is costlier than the same rubber when imported from Sri Lanka by a margin of Rs. 4.41/ Kg at the existing price and tariff levels. This shall be a source of concern for the Indian producers. However, two factors are favorable to the Indian growers now. Firstly, the exportable surplus of Sri Lanka has been significantly declining over time. It was a mere 32502 tonnes during 2000-01 (ANRPC, 2001). Secondly, Sri Lankan export is dominated by pale latex crepe, which finds specific industrials application only. India shall also develop mechanisms to monitor rules of origin, so that Sri Lankan rubber does not find entry in to India through a third country by re-export.

4.9.3 Elimination of Quantitative Restrictions (QRs)

The four immediate implications of the removal of QRs on the natural rubber sector are (i) Free importability under the Open General License (OGL) with duty, (ii) duty free importability under the Duty Entitlement Pass Book (DEPB) and the Duty Free Replenishment Certificate (DFRC) schemes. The extent of the natural rubber imports under the OGL, will be conditioned by difference between the prevailing domestic and international market prices, tax incidence on the domestic and imported rubber, freight, insurance and transportation charges and the trade policies of the major producing and consuming countries. This may not cause much concern now. However, major domestic industries can resort to duty free imports of natural rubber under the export incentive schemes of Advance Licensing Scheme (ALS). Though import of natural rubber under the ALS scheme has been banned by the Government of India (GOI) from February 1999, it has been re-introduced by the Ministry of Commerce, Government of India based on the Supreme Court verdict from 1st June 2003. Rubber product manufactures may import natural rubber through duty free channels of DEPB and DFRC schemes if the gap between the cost of locally procured rubber and international prices of natural rubber is higher than the freight, insurance and clearing charges of the imported shipments.

The most likely impact of the removal of QRs is perceived to be "surge in imports" into the country, thus adversely affecting the domestic

industry. However, import data for the full financial year 2000-01, on 714 items restrictions on which were removed with effect from 31-3-2000, did not reveal any surge in their imports following the removal of such restrictions. Out of the 714 items, no imports were made for 151 items either before or after the removal of QRs. Only 92 items recorded imports worth more than five crores (Government of India, 2002). The import of sensitive items reveal a growth (in dollar terms) of only 2.9 per cent in 2001 - 02 (Government of India, 2003).

Table 4.20 Import of natural rubber and Index numbers of import

Year	Import of NR (Tonnes)	Index number of import (Base : TE 1987-88 = 100)
1985-86	41431	91.75
1986-87	45356	100.44
1987-88	48685	107.81
1988-89	59836	132.51
1989-90	44445	98.42
1990-91	49013	108.54
1991-92	15070	33.37
1992-93	17884	39.60
1993-94	19940	44.16
1994-95	8093	17.92
1995-96	51635	114.34
1996-97	19770	43.78
1997-98	32070	71.02
1998-99	29534	65.40
1999-00	20213	44.76
2000-01	8970	19.86
2001-02	49590	109.82
Mean imports in the pre-WTO period (1985-86 to 1994-95)		**35975.30**
Mean imports in the post-WTO period (1995-96 to 2001-02)		**30254.57**

A scrutiny of import of natural rubber into India during the pre-WTO period from 1985-86 to 1994-95 and post-WTO period from 1995-96 to 2001-02 revealed that there was no significant change in the magnitude of imports after the removal of QRs. In fact, the average imports in the post-WTO period is lower than that of pre-WTO period (Table 4. 20). There has been decline in the import in the post -WTO period over the base year. There is no absolute increase in import during 2000-01 when the QR was removed. The year 2001-02 showed an increase in imports by 9.82 per cent over the base year import.

4.9.4 Safe-guard measure

After illustrating that there has not been any absolute increase in imports consequent to the removal of QR, the next task is to examine whether an increase in imports in relation to the domestic production has taken place so as to cause injury to the domestic sector. The details of the imports of natural rubber as percentage to the domestic production is given in Table 4. 21

Table 4.21 Import of natural rubber in relation to domestic production

(Tonnes)

Year	Domestic Production	Import	Import as % to the domestic production
1995-96	506910	51635	10.19
1996-97	545425	19770	3.60
1997-98	583830	32070	5.49
1998-99	605045	29534	4.88
1999-00	622265	20213	3.25
2000-01	630405	8970	1.42

The import as a percentage of production in the base year 1995-96 was around 10 per cent. It has been continuously on the decline and reached a level of 1.42 per cent during 2000-01. It may therefore be concluded that contrary to the popular perception, removal of QR has not resulted in either absolute or relative

increase in imports of natural rubber. Therefore there does not exist any case for invoking the safeguard measures in the case of natural rubber. However, the relative movement of imports with respect to domestic production are to be monitored vigorously for possible reversal of trends in future.

In the Agreement on Agriculture (AoA), Special Safeguard Measures (SSM), have been provided under certain conditions. However, natural rubber having been classified as an "industrial raw material", these provisions cannot be made operative.

4.9.5 Imposition of anti-dumping duties

As the details on the domestic price of producing countries and their export prices were not available country-wise, the question of dumping could not be examined critically. However, no written application with evidence is known to be registered by the agrieved parties under Article V of the Agreement on Anti- Dumping Duties (AAD). Neither the Government of India nor any of its agencies like the Rubber Board have conducted *suo motto* investigation in to the possible dumping of natural rubber in India. So, it may be concluded that dumping of natural rubber in the sheet or the block form may have not taken place in the era after the removal of QR. At the same time, Anti-Dumping Duties were imposed on NBR, Styrene Butadiene Rubber (SBR) and EPDM from Japan, NBR and SBR from Taiwan. (Goyal, 2000).

4.9.6 Domestic Support

In order to export natural rubber, exporters of natural rubber were given incentives at the rate of Rs. 2/ Kg of sheet rubber and Rs. 3.50/ kg of bulk rubber and latex. India is not a regular exporter of natural rubber as the export surplus is very low. As the per capita income of India is currently below US $ 1000 and share of Indian export of natural rubber in the world trade is below 3.25 per cent

(Table. 4.22), there is no commitment to reduce export subsidies. Therefore, the country can afford to provide more export incentives as of now

Table 4.22 Indian exports of natural rubber as percentage of world trade

(Tonnes)

Year	Export of NR from India	World trade of NR	Export as % of world trade
1994-95	1961	4575000	0.04
1995-96	1130	4860000	0.02
1996-97	1598	5001000	0.03
1997-98	1415	5274000	0.03
1998-99	1840	5217000	0.04
1999-00	5989	5722000	0.11
2000-01	13356	5678000	0.24

At present, there are no import substitution subsidies prevalent in India. hence the provisions is not binding as of now.

4.9.7. Non-Tariff imports

Being regular exporter of natural rubber, the production and processing practices prevailing in Thailand Indonesia, Malaysia and Vietnam are well oriented towards the export market. All these countries have well rooted marketing chain as well as have regular buyers in the international market. India's position is entirely different due to the presence of fairly captive domestic manufacturing sector, which absorbs almost entire domestic production of the natural rubber. The production and processing practices prevailing in the country have been highly inward oriented. (Desaplhine, 2001). If the Indian natural rubber had to gain entry into the international market, it has to not only strengthen its infrastructure for the marketing and processing but also develop a marketing system, which is in tune with the global trading practices.

Table 4.23 Different forms of natural rubber and their composition in India

Form	Share (per cent)
1. Ribbed Smoked Sheets	72.2
2. Latex Concentrates	10.5
3. Technically Specified Rubber	9.5
4. Others	7.8

(Rubber Board, 2002)

The Indian natural rubber processing sector is characterized by the domination of sheet rubber with a relative share of 72 per cent

The sheets processed by the small holders are generally of poor quality due to lack of cleanliness in latex collection, handling and coagulation, inadequacies in the addition of chemicals etc. Even when grading is done, only visual grading is followed. Technically Specified Rubber (TSR) is a modern form of marketable rubber in the international market. But only 10 per cent of the total rubber produced in India is processed now to TSR (Babu *et al*, 2000).

Any regulation related to the technical or sanitary standards imposed on the imported natural rubber should be equally applicable to natural rubber of the national origin. In India, natural rubber is not classified in the Appendix V of the schedule 1 of the ITC (HS) classification of the export and import items by the Government of India. This will make notified quality standards mandatory for 131 items included now. However technical quality standards mandatory for domestic processors under Rule 48 of the Rubber Rules 1955, are made applicable for imported rubber from December 19th 2001 (Government of India, 2001). There shall be regular and strict enforcement of technical quality standards of imported rubber so that substandard material doesn't find an entry in to the country.

SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSIONS

The study entitled "Production and Trade Competitive Advantages of Natural Rubber In India" was undertaken with the specific objectives to examine the emerging trends in production, consumption, export and import of natural rubber and to assess the competitive advantages and disadvantages in the specific context of WTO regime. The study was conducted during the year 2001-03.

The study was based on the secondary and primary data. The secondary data was collected from the Rubber Board and the Rubber Research Institute of India, Kottayam and Directorate of Economics and Statistics, Government of India. The primary data was collected from a cross-sectional survey of 30 farmers in different stages of crop stand from Trikkur Panchayath of Kodakkara Block in Thrissur district of Kerala. The area was selected in consultation with the officials of the Rubber Board Regional office, Thrissur and a simple random sampling procedure was used to select the respondents.

In order to analyze the growth pattern of natural rubber in Kerala and India with respect to total area, tapped area, production and yield across time period of 40 years from 1960-61 to 2000 -01,different trend lines were fitted for the data in hand. The best fit was selected based on the adjusted R^2 values, outlier values and standard error of the estimate. Out of the different functional forms like cubic, logistic, compound, logarithmic and quadratic production functions tried, it was found that a growth model of the type $Y = e^{(a+bt)}$ was found to be the best fit for tapped area, production and yield of natural rubber, Whereas for consumption of natural rubber, the exponential functional form turned out to be best fit.

Decade wise compound growth rate (CGR), of total area, tapped area, production and yield of natural rubber for all India data as well as Kerala data

were calculated. The analysis of the decade wise growth rate (GR) for all India data regarding the total area revealed that the compound growth rate was highest during the decade from 1980-81 to 1989-90 (5.54 %). The compound growth rate in this regard decelerated to 1.18 per cent during the nineties. The results for Kerala with respect to growth rate of tapped area were in concordance with the trend shown for all Indian pattern.

Decade wise CGR for tapped area for all India data were highest in the sixties (7.24 %). Similar was the case with the Kerala data also. The compound growth rate decelerated over the periods and was 2.72 per cent and 2.33 per cent respectively for all India and Kerala during the nineties. Decade wise compound growth rate for production also showed a higher growth rate during the sixties and then progressively decelerating over the decades. The CGR with respect to production was 6.53 and 6.28 per cent during the nineties, for all India and Kerala respectively. The yield too showed a higher growth rate during the sixties, both with respect to India and Kerala. The compound growth rate with respect to yield was 3.93 and 4.10 per cent for all India and Kerala data respectively during the nineties.

The production of reclaimed rubber had a higher growth rate in the seventies, which progressively decelerated over the decades and reached 1.13 per cent in the nineties. Similar was the case with the consumption of reclaimed rubber. However it is interesting to note that that growth rate of exports of reclaimed rubber revealed a higher growth rate in the nineties. The growth rate in the production of synthetic rubber decelerated from 22.59 per cent in the sixties to 2.15 per cent in the nineties. Though there was a negative growth rate in the import of synthetic rubber in the sixties (- 11.98 %), it turned to positive in the seventies (13.28 %).

The instability with respect to total area under natural rubber was highest during the eighties. The situation was similar for both India as well as Kerala. The

instability with respect to tapped area under the natural rubber was highest during the sixties. Similar was the result with instability analysis for production, with the instability being higher during the sixties. It slightly decreased in the seventies and then increased in the eighties. However it is to be noted that instability with respect to natural rubber decelerated in the nineties. The instability in the yield of natural rubber showed a higher instability during the sixties and nineties.

The instability analysis for production, import and consumption of synthetic rubber revealed that all the three parameters exhibited higher instability during the sixties. The instability declined progressively over the decades.

Additive and multiplicative decomposition models were used to estimate the area effect, productivity effect and the interaction effect of the output growth. Decomposition analysis by the additive model revealed that in the early seventies area and yield effect was more than the price effect. In the late seventies, there was a reduction in share of area and yield effect. During this period prices stated to exert an increasing influence towards growth in crop output. During the eighties price effect, played a decisive role towards increase in production than the area and yield effect.

The results of the decomposition analysis using the multiplicative model revealed that the price effect had a major contribution in accounting the growth in natural rubber production in India. It accounted for 65 per cent of the growth in production during the seventies. During the same period, area effect in growth in production was to the tune of 25 per cent while yield effect had a marginal role to play (9.78 %). During the eighties, the relative contribution of price came down to 37 per cent, while that of yield increased to nearly 25 per cent. The period corresponds with the massive expansion in area under natural rubber cultivation in India During the nineties, the relative contribution of the yield and price towards output growth was around 35 and 45 per cent respectively. During this period, area effect came down considerably.

In order to determine the production advantage of natural rubber in India, a financial feasibility analysis was carried out using the cash flow generated from the cross sectional survey. The resultant cash flow analysis revealed that the Pay Back Period (PBP) was eleven years, the benefit cost Ratio (BCR) was 1.49, the Net Present value (NPV) was Rs.72, 806 and the IRR was 20.74 per cent. Since the PBP was less than the project life, the BCR was greater than one, the NPV was positive and the IRR was greater than the cost of capital, the cultivation of natural rubber was financially feasible. The cost of production of RSS-4 grade rubber sheet was arrived at Rs. 25.48 / Kg. The corresponding price that was received by the farmer was Rs. 32.28 / Kg of rubber. Hence it was concluded that there was a tremendous production advantage for natural rubber for Indian farmers at the current cost structure and productivity levels.

Domestic Resource cost (DRC) ratio was used to assess the comparative advantage of the crop. The value of DRC ratio was greater than unity. Implying India does not have comparative advantage in producing natural rubber at the existing cost-return and productivity level for international trade.

NPC was estimated both under exportable hypothesis and importable hypothesis in order to assess the international competitiveness. Trade competitive advantage of natural rubber production was first assessed by calculating the NPC under the exportable hypothesis. The value of NPC under the exportable hypothesis was arrived at 1.18. It implied that India was not competitive for the export of natural rubber. The Nominal Protection Rate (NPR) revealed that during the reference period from 1979-80 to 2000-01, the domestic prices of natural rubber remained on an average 9 per cent higher than the international price

The value of NPC under importable hypothesis was arrived at 1.09. Since the value of NPC under importable hypotheses was greater than one, it indicates that Indian natural rubber is not enjoying trade competitive advantage at the existing levels of productivity and cost return structure. In other words import was cheaper than domestically produced natural rubber. A major factor contributing to

lack of competitiveness is the higher domestic price in relation to the international price.

The implications of the WTO agreements to the natural rubber sector was analysed under the seven different headings, viz., The provisions of the WTO having a direct bearing on natural rubber cultivation and trade were (1). Bound rates and applied tariff rates, (2). Commitments under the Most Favored Nation (MFN) exceptions, (3). Elimination of Quantitative Restrictions (QRs), (4). Safeguard Measures, (5). Anti-Dumping Duties, (6). Domestic Support and Export Subsidy, and (7). Non-tariff import restrictions.

Since natural rubber was classified as an "Industrial raw material", its bound duty was fixed at a low level of 25 per cent. This was in contrary to the items coming under other plantation crops, which were classified as agricultural products, and a higher bound rates was fixed. It means that while import duties of many agricultural products could be raised to protect the domestic market, while that of natural rubber cannot be done beyond 25 per cent.

India has committed to few MFN commitments. The more relevant one with respect to natural rubber was with Sri Lanka. The bound rate for natural rubber imports from Sri Lanka under the Indo-Sri Lankan Free Trade Agreement was fixed at 20 per cent instead of the committed 25 per cent. Hence the imports from Sri Lanka is cheaper than the domestically produced rubber by Rs. 4.41 per kilogram. The analysis of comparative costs of imported rubber from countries other than Sri Lanka revealed that with present tariff regime, the margin of cost between domestically produced rubber and imported rubber under the OGL was just Re. 0.15 / Kg. Any increase in the domestic price can upset this equilibrium, where by imported rubber becomes cheaper. It is because of this price sensitivity that natural rubber is now classified as a "sensitive item" to be monitored by the Inter-Ministerial Monitoring Group *viz.*, the " War Room".

The most likely impact of the removal of QRs is that it may result in surge in imports to the country, thus adversely affecting the domestic industry. A

scrutiny of import of natural rubber into India during the pre-WTO period from 1985-86 to 1994-95 and post-WTO period from 1995-96 to 2001-02 revealed that there was no significant change in the magnitude of imports after the removal of QRs. In fact, the average imports in the post-WTO period was lower than that of pre-WTO period. A comparison of the growth rate of imports also suggested that a "surge in imports" of natural rubber in India has not taken place.

Safeguard Measures can be initiated if there is a surge in the imports of a product into a country and thereby causing an 'injury' to domestic production. An analysis of import as percentage of domestic production revealed that a 'surge in the imports' have not taken place and there arise no specific case for invoking the Safeguard Measure.

Though, Anti-Dumping Duties were imposed on NBR, Styrene Butadiene Rubber (SBR) and EPDM from Japan, NBR and SBR from Taiwan, dumping in the case of natural rubber was not reported after the removal of QRs.

Indian exporters of natural rubber were given incentives at the rate of Rs. 2/ Kg of sheet rubber and Rs. 3.50/ kg of bulk rubber and latex in the year 2000-01. India is not a regular exporter as the export surplus is very low. India can provide export subsidies as of now with in the commitments of the WTO, on two grounds. Firstly, the per capita income of India is less than US $ 1000. So, India can avail the facility for developing countries. Secondly, the exports from India have not reached 3.25 per cent of the total world trade in natural rubber.

India has a fairly captive domestic manufacturing sector, which absorbs almost entire domestic production of the natural rubber. Also, the Indian natural rubber processing sector is characterized by the domination of sheet rubber with a relative share of 72 per cent. However, the global market is tilting in favour of Technically Specified Rubber (TSR), which accounts for only 10 per cent of domestic production of natural rubber in India. It is to be noted that the sheets processed by the small holders in India are generally of poor quality due to lack of

cleanliness in latex collection, handling and coagulation, inadequacies in adding of chemicals etc. Any regulation related to the technical or sanitary standards imposed on the imported natural rubber should be equally applicable to natural rubber of the national origin. Technical quality standards, mandatory for domestic processors under Rule 48 of the Rubber Rules 1955, are made applicable for imported rubber from December 19th 2001. There shall be regular and strict enforcement of Technical Quality Standards of imported rubber so that substandard material does not find an entry in to the country.

Policy implications

Based on the findings of the study the following policy implications emerge:

(i) The current yield of natural rubber in the country (1576 kg / ha) is one of the highest in any rubber producing countries, the closest being 1362 Kg/ ha from Thailand and 1089 kg / ha from China. The yield in Indonesia, Sri Lanka and Malaysia are much low. (655, 857,and 980 Kg/ ha respectively). However, there is still scope for improving the current yield levels through better agro-techniques and quality up-gradation of stocks. Any further improvement in the yield can make natural rubber production more cost effective, which is pre-requisite to make it more competitive internationally.

(ii) The current classification of natural rubber as an "industrial raw material" is a misnomer and totally unjustifiable. Natural rubber is 'primary product of farm in its natural form' under the Article XVI of the GATT, 1994. Natural rubber should have been classified as an agricultural commodity as all farm level processing customarily required to prepare it for marketing only is carried out. It is basically a small holder crop,

cultivated just like any other plantation crops like tea, coffee, coconut, cashew etc. Income from Rubber plantation is treated as agricultural income for all taxation purposes. Moreover, the United Nations Conference on Trade and Development (UNCTAD) and the World Bank Common Fund for Commodities have categorized natural rubber as an agricultural product, grouping it along cotton and jute in the sub-group of agricultural raw materials. The reclassification of rubber as an agricultural product has tremendous policy implications. This single step done would enable the enhancement of bound rate for natural rubber upto 100 per cent. Secondly, under the Article V of the Agreement on Agriculture (AoA), it would enable the producer countries, who are the members of WTO, to impose the Special Safeguard Provisions (SSG), if there is a serious injury or even a threat of serious injury to domestic production under the conditions of import price falling below the 1985-86 c. i. f price level (price trigger) or quantity of imports exceeding 10 per cent of the above domestic consumption levels (quantity trigger). This SSG provides additional flexibility to a member nations because they are entitled to impose additional duty, if the import exceeds trigger levels. In a commodity like natural rubber, where the margin between border price and domestic price is narrow, any additional duty will make imports unattractive. Thus, this is an appropriate case for renegotiation.

(iii) Conversion of fresh rubber latex into ribbed smoked sheets is the oldest method of processing. This is practiced in India because of low investment needed for the smokehouse and rubber roller machine and the low cost of processing into sheets. When the synthetic rubber dominated the international market during the sixteen and seventies, synthetic rubber was marketed in compact, uniform and medium sized bales wrapped in low

density polythene. When the natural rubber regained prominence over the synthetic rubber, the need for processing it into a form comparable to that of synthetic rubber was widely felt. The end result was compact, medium sized block of technically graded rubber warped in polythene, called Technically Specified Rubber (TSR). TSR was not only assured quality but also preferred more for the ease of handling, cleanliness and consistency. It occupies less storage space and reduces processing time. That is why TSR accounts for more than 50 per cent of the world trade in natural rubber. Major producing countries like Thailand, Indonesia and Malaysia have already switched over to the production of TSR on a large scale for export, while India is still following the conventional practice of processing into sheet rubber. Export orientation and international competitiveness calls for fulfilling the consumer demand and quality standards. Though individual level TSR processing may not be feasible immediately, the Rubber Board and the Rubber Producing Societies (RPS) can provide the leadership in establishing group processing facilities for the TSR production.

(iv) There is no technical grading of sheet rubber as of now. There is only provision for visual grading of sheet rubber Absence of grading at the producer's level, compels the producers to sell un-graded lot to the private traders at lower prices. Systematic grading will help the growers to earn more income for their output.

(v) At present duty free imports of natural rubber is possible only through the Advance Licensing Scheme (ALS). As the import under the scheme is allowed only through designated ports, viz., Kolkota and Vishakapatanam, monitoring is easy. The Rubber manufacturing sector is demanding import under the ALS through 'ports of choice' in order to provide level playing field for both the growers and industry. The

Government of India is most likely to accept this demand. But this facility shall be given only to the importers with adequate precautions to prevent misuse of duty free import facilty.

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APPENDICES

APPENDIX I

SURVEY SCHEDULE FOR ASSESSING THE FINANCIAL FEASIBILITY OF RUBBER CULTIVATION

1. Name and Address of the farmer :

2. Village and panchayath :
3. Date of interview :
4. Family composition

Sl. No.	Name	Sex	Age	Educational Qualification	Involved in farm operations Y/N	If employed else where give details	Family labour compo-nent

5. No. of years engaged in rubber cultivation
6. Details of land holding in (acres)

Particulars	Owned	Leased in	Leased out	Area available for cultivation	Current fallow	Area available for cultivation more than once
a) Wet land						
b)Garden land						

7. Cropping pattern

a) owned

Crops		Area (acres)/	No. of trees
Seasonal			
Annual			
Perennial			

b) leased in

9.d). Establishment cost (operation wise)

9.e). Cost of maintenance (operation wise)

10. Tapping details

10.a). No of tapping days

10.b). Tapping charge per tree

10.c). Yield per tree

i. Peak yield

ii. Average yield

iii. Trough yield

11. Processing charges

12 Average farm harvest price

13. Seasonal variation in price

14.a. Average loss incurred during the last 4 – 5 years due to price fall and liberalized import.

14.b. No of tappings reduced due to price fall

15. Mode of marketing

16.a). Constraints / problems faced in rubber production (if any)

16.b). Constraints / problems faced in marketing (if any)

Appendix II

Discounted cash flow anlysis for calculation of PBP, BCR, NPV and IRR - without the salvage value

Year	CI	O&M	COF	Total yield	total no of trees	Income from sheet rubber @Rs 32.28/ Kg	Total yield of scrap rubber (kg)	Income from scrap rubber @Rs 24.21 / Kg	Total income (sheet + Scrap) = CIF	CASH FLOW	discounted Cash out flow	discounted Cash inflow	Discounted Cash flow	unrecovered balance
1978-79	22810.00	4544.30	27354.30		400	*0.00*	0.0	0.00	0.00	-27354.30	24423.48	0.00	-24423.48	27354.30
1979-80	4405.00	3987.28	8392.28		400	*0.00*	0.0	0.00	0.00	-8392.28	6690.27	0.00	-6690.27	35746.58
1980-81	0.00	3589.30	3589.30		400	*0.00*	0.0	0.00	0.00	-3589.30	2554.79	0.00	-2554.79	39335.88
1981-82	0.00	3816.50	3816.50		400	*0.00*	0.0	0.00	0.00	-3816.50	2425.45	0.00	-2425.45	43152.38
1982-83	0.00	6072.70	6072.70		400	*0.00*	0.0	0.00	0.00	-6072.70	3445.81	0.00	-3445.81	49225.08
1983-84	0.00	7953.76	7953.76		400	*0.00*	0.0	0.00	0.00	-7953.76	4029.62	0.00	-4029.62	57178.84
1984-85	33867.43	9746.40	43613.83	*478.00*	400	*15429.84*	38.3	1466.89	16896.73	-26717.10	19728.68	7643.22	-12085.46	83895.94
1985-86	0.00	20391.90	20391.90	*950.00*	400	*30666.00*	75.0	5625.00	36291.00	15899.10	8235.95	14657.33	6421.38	67996.84
1986-87	0.00	21156.90	21156.90	*1050.00*	400	*33894.00*	80.0	6400.00	40294.00	19137.10	7629.39	14530.42	6901.03	48859.74
1987-88	0.00	22606.90	22606.90	*1250.00*	400	*40350.00*	90.0	8100.00	48450.00	25843.10	7278.82	15599.60	8320.79	23016.64
1988-89	0.00	24092.90	24092.90	*1500.00*	400	*48420.00*	100.0	10000.00	58420.00	34327.10	6926.13	16794.35	9868.22	-11310.46
1989-90	0.00	26340.00	26340.00	*1700.00*	400	*54876.00*	110.0	12100.00	66976.00	40636.00	6760.82	17191.07	10430.25	0.67
1990-91	0.00	26744.00	26744.00	*2000.00*	385	*64560.00*	110.7	12251.72	76811.72	50067.72	6129.03	17603.26	11474.23	
1991-92	0.00	27487.00	27487.00	*2400.00*	385	*77472.00*	115.5	13340.25	90812.25	63325.25	5624.38	18581.99	12957.60	
1992-93	0.00	29648.52	29648.52	*2400.00*	385	*77472.00*	120.3	14475.10	91947.10	62298.58	5416.67	16798.39	11381.72	
1993-94	0.00	30117.00	30117.00	*2400.00*	385	*77472.00*	120.3	14475.10	91947.10	61830.10	4912.74	14998.56	10085.83	
1994-95	0.00	30117.00	30117.00	*2200.00*	385	*71016.00*	120.3	14475.10	85491.10	55374.10	4386.37	12451.29	8064.92	
1995-96	0.00	30775.40	30775.40	*2140.00*	350	*69079.20*	113.8	12939.06	82018.26	51242.86	4002.02	10665.62	6663.60	
1996-97	0.00	25393.24	25393.24	*2000.00*	350	*64560.00*	113.8	12939.06	77499.06	52105.82	2948.33	8998.17	6049.84	
1997-98	0.00	29902.05	29902.05	*1755.00*	350	*56651.40*	113.8	12939.06	69590.46	39688.41	3099.85	7214.22	4114.37	
1998-99	0.00	29626.56	29626.56	*1572.00*	350	*50744.16*	113.8	12939.06	63683.22	34056.66	2742.22	5894.49	3152.27	
1999-00	0.00	47766.00	47766.00	*1851.00*	350	*60718.68*	122.5	15006.25	75724.93	27958.93	3947.50	6258.10	2310.60	
2000-01	0.00	53909.47	53909.47	*1720.00*	340	*55521.60*	136.0	18496.00	74017.60	20108.13	3977.87	5461.61	1483.74	
2001-02				*29396.00*							147316.22	211341.70	64025.48	

NPV =	64025.5	BCR =	1.435
IRR =	20.33%	PBP =	10.67 years ~ = 11 years

CI = Capital investment

O &M = Operational and maintenance costs

COF = Cash outflow, CIF = Cash Inflow ,

APPENDIX III

Sensitivity analysis with price of rubber at 25/ Kg and scrap rubber at 18.75/ Kg

Year	CI	O&M	COF	*Total yield*	Income from sheet rubber @Rs 25/ Kg	yield of scrap rubber	Income from scrap rubber @Rs 18.75/ Kg	CIF	Cash flow	Discount factor	DCIF	DCOF	Discounted cash flow	un rec balance
1	22810.00	4544.30	27354.30	*0.00*	0	0.00	0	0	-27354.30	0.8929	0	24423.48	-24423.48	27354
2	4405.00	3987.28	8392.28	*0.00*	0	0.00	0	0	-8392.28	0.7972	0	6690.274	-6690.274	35746.28
3	0.00	3589.30	3589.30	*0.00*	0	0.00	0	0	-3589.30	0.7118	0	2554.793	-2554.793	39335.58
4	0.00	3816.50	3816.50	*0.00*	0	0.00	0	0	-3816.50	0.6355	0	2425.455	-2425.455	43152.08
5	0.00	6072.70	6072.70	*0.00*	0	0.00	0	0	-6072.70	0.5674	0	3445.813	-3445.813	49224.78
6	0.00	7953.76	7953.76	*0.00*	0	0.00	0	0	-7953.76	0.5066	0	4029.622	-4029.622	57178.54
7	33867.43	9746.40	43613.83	*478.00*	11950	38.30	718.125	12668.13	-30945.70	0.4523	5730.416	19728.68	-13998.27	88124.24
8	0.00	20391.90	20391.90	*950.00*	23750	75.00	1406.25	25156.25	4764.35	0.4039	10160.19	8235.946	1924.241	83359.89
9	0.00	21156.90	21156.90	*1050.00*	26250	80.00	1500	27750	6593.10	0.3606	10006.93	7629.39	2377.538	76766.79
10	0.00	22606.90	22606.90	*1250.00*	31250	90.00	1687.5	32937.5	10330.60	0.3220	10604.99	7278.817	3326.177	66436.19
11	0.00	24092.90	24092.90	*1500.00*	37500	100.00	1875	39375	15282.10	0.2875	11319.37	6926.133	4393.239	51154.09
12	0.00	26340.00	26340.00	*1700.00*	42500	110.00	2062.5	44562.5	18222.50	0.2567	11438.08	6760.822	4677.262	32931.59
13	0.00	26744.00	26744.00	*2000.00*	50000	110.69	2075.4375	52075.44	25331.44	0.2292	11934.35	6129.035	5805.312	7600.16
14	0.00	27487.00	27487.00	*2400.00*	60000	115.50	2165.625	62165.63	34678.63	0.2046	12720.32	5624.385	7095.934	-27078.47
15	0.00	29648.52	29648.52	*2400.00*	60000	120.31	2255.8125	62255.81	32607.29	0.1827	11373.9	5416.674	5957.23	
16	0.00	30117.00	30117.00	*2400.00*	60000	120.31	2255.8125	62255.81	32138.81	0.1631	10155.27	4912.735	5242.537	0.2191597
17	0.00	30117.00	30117.00	*2200.00*	55000	210.31	3943.3125	58943.31	28826.31	0.1456	8584.76	4386.371	4198.389	
18	0.00	30775.40	30775.40	*2140.00*	53500	113.75	2132.8125	55632.81	24857.41	0.1300	7234.468	4002.02	3232.448	
19	0.00	25393.24	25393.24	*2000.00*	50000	113.75	2132.8125	52132.81	26739.57	0.1161	6052.973	2948.327	3104.646	
20	0.00	29902.05	29902.05	*1755.00*	43875	113.75	2132.8125	46007.81	16105.76	0.1037	4769.481	3099.849	1669.632	
21	0.00	29626.56	29626.56	*1572.00*	39300	113.75	2132.8125	41432.81	11806.25	0.0926	3835.005	2742.223	1092.782	
22	0.00	47766.00	47766.00	*1881.00*	47025	122.50	2296.875	49321.88	1555.88	0.0826	4076.084	3947.502	128.5814	
23	0.00	53909.47	53909.47	*1720.00*	43000	136.00	2550	164550	110640.53	0.0738	12141.81	3977.87	8163.939	
											152138.4	147316.2	4822.181	

Pay Back Period = 14 years		Net Present Value =	4822.181
Benefit-Cost ratio =	1.032734	IRR=	12.76%

sensitivity analysis with price of rubber at 30/ Kg and scrap rubber at 22.50 Kg

Year	CI	O&M	COF	*Total yield*	Income from sheet rubber @Rs 30/ Kg	yield of scrap rubber	Income from scrap rubber @Rs 22.50/ Kg	CIF	Cash flow	Discount factor	DCIF	DCOF	Discounted cash flow	
1	22810.00	4544.30	27354.30		0	0.00	0	0	-27354.30	0.8929	0	24423.48	-24423.5	27354.3
2	4405.00	3987.28	8392.28		0	0.00	0	0	-8392.28	0.7972	0	6690.274	-6690.27	35746.58
3	0.00	3589.30	3589.30		0	0.00	0	0	-3589.30	0.7118	0	2554.793	-2554.79	39335.88
4	0.00	3816.50	3816.50		0	0.00	0	0	-3816.50	0.6355	0	2425.455	-2425.45	43152.38
5	0.00	6072.70	6072.70		0	0.00	0	0	-6072.70	0.5674	0	3445.813	-3445.81	49225.08
6	0.00	7953.76	7953.76		0	0.00	0	0	-7953.76	0.5066	0	4029.622	-4029.62	57178.84
7	33867.43	9746.40	43613.83	*478.00*	14340	38.30	861.75	15201.75	-28412.08	0.4523	6876.5	19728.68	-12852.2	85590.92
8	0.00	20391.90	20391.90	*950.00*	28500	75.00	1687.5	30187.5	9795.60	0.4039	12192.22	8235.946	3956.279	75795.32
9	0.00	21156.90	21156.90	*1050.00*	31500	80.00	1800	33300	12143.10	0.3606	12008.31	7629.39	4378.924	63652.22
10	0.00	22606.90	22606.90	*1250.00*	37500	90.00	2025	39525	16918.10	0.3220	12725.99	7278.817	5447.175	46734.12
11	0.00	24092.90	24092.90	*1500.00*	45000	100.00	2250	47250	23157.10	0.2875	13583.25	6926.133	6657.113	23577.02
12	0.00	26340.00	26340.00	*1700.00*	51000	110.00	2475	53475	27135.00	0.2567	13725.7	6760.822	6964.879	-3557.98
13	0.00	26744.00	26744.00	*2000.00*	60000	110.69	2490.525	62490.53	35746.53	0.2292	14321.22	6129.035	8192.181	
14	0.00	27487.00	27487.00	*2400.00*	72000	115.50	2598.75	74598.75	47111.75	0.2046	15264.38	5624.385	9639.997	0.8688785
15	0.00	29648.52	29648.52	*2400.00*	72000	120.31	2706.975	74706.98	45058.46	0.1827	13648.69	5416.674	8232.011	
16	0.00	30117.00	30117.00	*2400.00*	72000	120.31	2706.975	74706.98	44589.98	0.1631	12186.33	4912.735	7273.591	
17	0.00	30117.00	30117.00	*2200.00*	66000	210.31	4731.975	70731.98	40614.98	0.1456	10301.71	4386.371	5915.341	
18	0.00	30775.40	30775.40	*2140.00*	64200	113.75	2559.375	66759.38	35983.98	0.1300	8681.362	4002.02	4679.341	
19	0.00	25393.24	25393.24	*2000.00*	60000	113.75	2559.375	62559.38	37166.14	0.1161	7263.567	2948.327	4315.24	
20	0.00	29902.05	29902.05	*1755.00*	52650	113.75	2559.375	55209.38	25307.33	0.1037	5723.377	3099.849	2623.529	
21	0.00	29626.56	29626.56	*1572.00*	47160	113.75	2559.375	49719.38	20092.82	0.0926	4602.006	2742.223	1859.783	
22	0.00	47766.00	47766.00	*1881.00*	56430	122.50	2756.25	59186.25	11420.25	0.0826	4891.3	3947.502	943.7981	
23	0.00	53909.47	53909.47	*1720.00*	51600	136.00	3060	173660	119750.53	0.0738	12814.02	3977.87	8836.147	
											180809.9	**147316.2**	33493.71	

Pay Back Period =	12years	Benefit-Cost ratio =	1.227359
Net Present Value =	33493.71	IRR =	16.66%

sensitivity analysis with price of rubber at 29/ Kg and scrap rubber at 21.75/ Kg

Year	CI	O&M	COF	*Total yield*	Income from sheet rubber @Rs 29/ Kg	yield of scrap rubber	Income from scrap rubber @Rs 21.75/ Kg	CIF	Cash flow	Discount factor	DCIF	DCOF	Discounted cash flow	
1	22810.00	4544.30	27354.30		0	0.00	0	0	-27354.30	0.8929	0	24423.48	-24423.48	27354.3
2	4405.00	3987.28	8392.28		0	0.00	0	0	-8392.28	0.7972	0	6690.274	-6690.274	35746.58
3	0.00	3589.30	3589.30		0	0.00	0	0	-3589.30	0.7118	0	2554.793	-2554.793	39335.88
4	0.00	3816.50	3816.50		0	0.00	0	0	-3816.50	0.6355	0	2425.455	-2425.455	43152.38
5	0.00	6072.70	6072.70		0	0.00	0	0	-6072.70	0.5674	0	3445.813	-3445.813	49225.08
6	0.00	7953.76	7953.76		0	0.00	0	0	-7953.76	0.5066	0	4029.622	-4029.622	57178.84
7	33867.43	9746.40	43613.83	*478.00*	13862	38.30	833.025	14695.03	-28918.80	0.4523	6647.283	19728.68	-13081.4	86097.64
8	0.00	20391.90	20391.90	*950.00*	27550	75.00	1631.25	29181.25	8789.35	0.4039	11785.82	8235.946	3549.671	77308.29
9	0.00	21156.90	21156.90	*1050.00*	30450	80.00	1740	32190	11033.10	0.3606	11608.04	7629.39	3978.646	66275.19
10	0.00	22606.90	22606.90	*1250.00*	36250	90.00	1957.5	38207.5	15600.60	0.3220	12301.79	7278.817	5022.976	50674.59
11	0.00	24092.90	24092.90	*1500.00*	43500	100.00	2175	45675	21582.10	0.2875	13130.47	6926.133	6204.338	29092.49
12	0.00	26340.00	26340.00	*1700.00*	49300	110.00	2392.5	51692.5	25352.50	0.2567	13268.18	6760.822	6507.355	3739.99
13	0.00	26744.00	26744.00	*2000.00*	58000	110.69	2407.508	60407.51	33663.51	0.2292	13843.84	6129.035	7714.807	-29923.51
14	0.00	27487.00	27487.00	*2400.00*	69600	115.50	2512.125	72112.13	44625.13	0.2046	14755.57	5624.385	9131.185	
15	0.00	29648.52	29648.52	*2400.00*	69600	120.31	2616.743	72216.74	42568.22	0.1827	13193.73	5416.674	7777.055	0.111099
16	0.00	30117.00	30117.00	*2400.00*	69600	120.31	2616.743	72216.74	42099.74	0.1631	11780.12	4912.735	6867.38	
17	0.00	30117.00	30117.00	*2200.00*	63800	210.31	4574.243	68374.24	38257.24	0.1456	9958.321	4386.371	5571.951	
18	0.00	30775.40	30775.40	*2140.00*	62060	113.75	2474.063	64534.06	33758.66	0.1300	8391.983	4002.02	4389.963	
19	0.00	25393.24	25393.24	*2000.00*	58000	113.75	2474.063	60474.06	35080.82	0.1161	7021.448	2948.327	4073.121	
20	0.00	29902.05	29902.05	*1755.00*	50895	113.75	2474.063	53369.06	23467.01	0.1037	5532.598	3099.849	2432.749	
21	0.00	29626.56	29626.56	*1572.00*	45588	113.75	2474.063	48062.06	18435.50	0.0926	4448.606	2742.223	1706.383	
22	0.00	47766.00	47766.00	*1881.00*	54549	122.50	2664.375	57213.38	9447.38	0.0826	4728.257	3947.502	780.7548	
23	0.00	53909.47	53909.47	*1720.00*	49880	136.00	2958	171838	117928.53	0.0738	12679.57	3977.87	8701.705	
											175075.6	147316.2	27759.4	

IRR 15.95% Benefit-Cost ratio = 1.188434

Net Present Value = 27759.4 Pay Back Period = 13 years

Sensitivity analysis with price of rubber at 27/ Kg and scrap rubber at 20.25/ Kg

Year	CI	O&M	COF	*Total yield*	Income from sheet rubber @Rs 27/ Kg	yield of scrap rubber	Income from scrap rubber @Rs 20.25/ Kg	CIF	Cash flow	Discount factor	DCIF	DCOF	Discounted cash flow	
1	22810.00	4544.30	27354.30	*0.00*	0	0.00	0	0	-27354.30	0.8929	0	24423.48	-24423.5	27354.3
2	4405.00	3987.28	8392.28	*0.00*	0	0.00	0	0	-8392.28	0.7972	0	6690.274	-6690.27	35746.58
3	0.00	3589.30	3589.30	*0.00*	0	0.00	0	0	-3589.30	0.7118	0	2554.793	-2554.79	39335.88
4	0.00	3816.50	3816.50	*0.00*	0	0.00	0	0	-3816.50	0.6355	0	2425.455	-2425.45	43152.38
5	0.00	6072.70	6072.70	*0.00*	0	0.00	0	0	-6072.70	0.5674	0	3445.813	-3445.81	49225.08
6	0.00	7953.76	7953.76	*0.00*	0	0.00	0	0	-7953.76	0.5066	0	4029.622	-4029.62	57178.84
7	33867.43	9746.40	43613.83	*478.00*	12906	38.30	775.575	13681.58	-29932.25	0.4523	6188.85	19728.68	-13539.8	87111.09
8	0.00	20391.90	20391.90	*950.00*	25650	75.00	1518.75	27168.75	6776.85	0.4039	10973	8235.946	2737.056	80334.24
9	0.00	21156.90	21156.90	*1050.00*	28350	80.00	1620	29970	8813.10	0.3606	10807.48	7629.39	3178.092	71521.14
10	0.00	22606.90	22606.90	*1250.00*	33750	90.00	1822.5	35572.5	12965.60	0.3220	11453.39	7278.817	4174.576	58555.54
11	0.00	24092.90	24092.90	*1500.00*	40500	100.00	2025	42525	18432.10	0.2875	12224.92	6926.133	5298.788	40123.44
12	0.00	26340.00	26340.00	*1700.00*	45900	110.00	2227.5	48127.5	21787.50	0.2567	12353.13	6760.822	5592.309	18335.94
13	0.00	26744.00	26744.00	*2000.00*	54000	110.69	2241.4725	56241.47	29497.47	0.2292	12889.09	6129.035	6760.059	-1161.53
14	0.00	27487.00	27487.00	*2400.00*	64800	115.50	2338.875	67138.88	39651.88	0.2046	13737.94	5624.385	8113.559	
15	0.00	29648.52	29648.52	*2400.00*	64800	120.31	2436.2775	67236.28	37587.76	0.1827	12283.82	5416.674	6867.143	0.621611
16	0.00	30117.00	30117.00	*2400.00*	64800	120.31	2436.2775	67236.28	37119.28	0.1631	10967.69	4912.735	6054.958	
17	0.00	30117.00	30117.00	*2200.00*	59400	210.31	4258.7775	63658.78	33541.78	0.1456	9271.541	4386.371	4885.17	
18	0.00	30775.40	30775.40	*2140.00*	57780	113.75	2303.4375	60083.44	29308.04	0.1300	7813.226	4002.02	3811.205	
19	0.00	25393.24	25393.24	*2000.00*	54000	113.75	2303.4375	56303.44	30910.20	0.1161	6537.211	2948.327	3588.883	
20	0.00	29902.05	29902.05	*1755.00*	47385	113.75	2303.4375	49688.44	19786.39	0.1037	5151.04	3099.849	2051.191	
21	0.00	29626.56	29626.56	*1572.00*	42444	113.75	2303.4375	44747.44	15120.88	0.0926	4141.805	2742.223	1399.583	
22	0.00	47766.00	47766.00	*1881.00*	50787	122.50	2480.625	53267.63	5501.63	0.0826	4402.17	3947.502	454.6681	
23	0.00	53909.47	53909.47	*1720.00*	46440	136.00	2754	168194	114284.53	0.0738	12410.69	3977.87	8432.822	
											163607	147316.2	16290.79	

Benefit-Cost ratio= 1.110584 Net Present Value = 16290.79

IRR 14.43% Pay Back Period = 13 years

Sensitivity analysis with 15 per cent increase in O & M

Year	CI	O&M	COF	*Total yield*	*New COF*	Income from sheet rubber @Rs 32.28/ Kg	yield of scrap rubber	Income from scrap rubber @Rs 24.21/ Kg	CIF	Cash flow	Discount factor	DCIF	DCOF	Discounted cash flow	
1	22810.00	4544.30	27354.30	*0.00*	*28035.95*	0.00	0.00	0.00	0.00	-28035.95	0.8929	0.00	25032.09	-25032.09	28035.95
2	4405.00	3987.28	8392.28	*0.00*	*8990.37*	0.00	0.00	0.00	0.00	-8990.37	0.7972	0.00	7167.07	-7167.07	37026.32
3	0.00	3589.30	3589.30	*0.00*	*4127.70*	0.00	0.00	0.00	0.00	-4127.70	0.7118	0.00	2938.01	-2938.01	41154.02
4	0.00	3816.50	3816.50	*0.00*	*4388.98*	0.00	0.00	0.00	0.00	-4388.98	0.6355	0.00	2789.27	-2789.27	45542.99
5	0.00	6072.70	6072.70	*0.00*	*6983.61*	0.00	0.00	0.00	0.00	-6983.61	0.5674	0.00	3962.69	-3962.69	52526.60
6	0.00	7953.76	7953.76	*0.00*	*9146.82*	0.00	0.00	0.00	0.00	-9146.82	0.5066	0.00	4634.07	-4634.07	61673.42
7	33867.43	9746.40	43613.83	*478.00*	*45075.79*	15429.84	38.30	927.24	16357.08	-28718.71	0.4523	7399.11	20390.00	-12990.88	90392.13
8	0.00	20391.90	20391.90	*950.00*	*23450.69*	30666.00	75.00	1815.75	32481.75	9031.07	0.4039	13118.83	9471.34	3647.50	81361.06
9	0.00	21156.90	21156.90	*1050.00*	*24330.44*	33894.00	80.00	1936.80	35830.80	11500.37	0.3606	12920.95	8773.80	4147.15	69860.70
10	0.00	22606.90	22606.90	*1250.00*	*25997.94*	40350.00	90.00	2178.90	42528.90	16530.97	0.3220	13693.17	8370.64	5322.53	53329.73
11	0.00	24092.90	24092.90	*1500.00*	*27706.84*	48420.00	100.00	2421.00	50841.00	23134.17	0.2875	14615.57	7965.05	6650.52	30195.57
12	0.00	26340.00	26340.00	*1700.00*	*30291.00*	54876.00	110.00	2663.10	57539.10	27248.10	0.2567	14768.85	7774.95	6993.91	2947.47
13	0.00	26744.00	26744.00	*2000.00*	*30755.60*	64560.00	110.69	2679.80	67239.80	36484.20	0.2292	15409.63	7048.39	8361.24	-33536.74
14	0.00	27487.00	27487.00	*2400.00*	*31610.05*	77472.00	115.50	2796.26	80268.26	48658.21	0.2046	16424.48	6468.04	9956.43	
15	0.00	29648.52	29648.52	*2400.00*	*34095.80*	77472.00	120.31	2912.71	80384.71	46288.91	0.1827	14685.99	6229.17	8456.81	0.08
16	0.00	30117.00	30117.00	*2400.00*	*34634.55*	77472.00	120.31	2912.71	80384.71	45750.16	0.1631	13112.49	5649.65	7462.84	
17	0.00	30117.00	30117.00	*2200.00*	*34634.55*	71016.00	210.31	5091.61	76107.61	41473.06	0.1456	11084.64	5044.33	6040.32	
18	0.00	30775.40	30775.40	*2140.00*	*35391.71*	69079.20	113.75	2753.89	71833.09	36441.38	0.1300	9341.15	4602.32	4738.82	
19	0.00	25393.24	25393.24	*2000.00*	*29202.23*	64560.00	113.75	2753.89	67313.89	38111.66	0.1161	7815.60	3390.58	4425.02	
20	0.00	29902.05	29902.05	*1755.00*	*34387.36*	56651.40	113.75	2753.89	59405.29	25017.93	0.1037	6158.35	3564.83	2593.53	
21	0.00	29626.56	29626.56	*1572.00*	*34070.54*	50744.16	113.75	2753.89	53498.05	19427.50	0.0926	4951.76	3153.56	1798.20	
22	0.00	47766.00	47766.00	*1881.00*	*54930.90*	60718.68	122.50	2965.73	63684.41	8753.51	0.0826	5263.04	4539.63	723.41	
23	0.00	53909.47	53909.47	*1720.00*	*61995.89*	55521.60	136.00	3292.56	177814.16	115818.27	0.0738	13120.54	4574.55	8545.99	
												193884.14	163534.01	30350.13	

BCR	1.186	NPV =	30350.13
IRR =	16.10%	PBP	13 years

Sensitivity analysis with 15 per cent decrease in CIF

Year	CI	O&M	COF	Total yield	New COF	Income from sheet rubber @Rs 32.28/ Kg	yield of scrap rubber	Income from scrap rubber @Rs 24.21/ Kg	CIF	New CIF	Cash flow	Discount factor	DCIF	DCOF	Discounted cash flow	
1	22810	4544.30	27354.30	0.00	27354.30	0.00	0.00	0.00	0.00	0.00	-27354.30	0.89	0.00	24423.48	-24423.48	27354.30
2	4405	3987.28	8392.28	0.00	8392.28	0.00	0.00	0.00	0.00	0.00	-8392.28	0.80	0.00	6690.27	-6690.27	35746.58
3	0	3589.30	3589.30	0.00	3589.30	0.00	0.00	0.00	0.00	0.00	-3589.30	0.71	0.00	2554.79	-2554.79	39335.88
4	0	3816.50	3816.50	0.00	3816.50	0.00	0.00	0.00	0.00	0.00	-3816.50	0.64	0.00	2425.45	-2425.45	43152.38
5	0	6072.70	6072.70	0.00	6072.70	0.00	0.00	0.00	0.00	0.00	-6072.70	0.57	0.00	3445.81	-3445.81	49225.08
6	0	7953.76	7953.76	0.00	7953.76	0.00	0.00	0.00	0.00	0.00	-7953.76	0.51	0.00	4029.62	-4029.62	57178.84
7	33867.429	9746.40	43613.83	478.00	43613.83	15429.84	38.30	927.24	16357.08	13903.52	-29710.31	0.45	6289.25	19728.68	-13439.43	86889.15
8	0	20391.90	20391.90	950.00	20391.90	30666.00	75.00	1815.75	32481.75	27609.49	7217.59	0.40	11151.01	8235.95	2915.06	79671.56
9	0	21156.90	21156.90	1050.00	21156.90	33894.00	80.00	1936.80	35830.80	30456.18	9299.28	0.36	10982.80	7629.39	3353.41	70372.28
10	0	22606.90	22606.90	1250.00	22606.90	40350.00	90.00	2178.90	42528.90	36149.57	13542.67	0.32	11639.19	7278.82	4360.38	56829.62
11	0	24092.90	24092.90	1500.00	24092.90	48420.00	100.00	2421.00	50841.00	43214.85	19121.95	0.29	12423.24	6926.13	5497.10	37707.67
12	0	26340.00	26340.00	1700.00	26340.00	54876.00	110.00	2663.10	57539.10	48908.24	22568.24	0.26	12553.53	6760.82	5792.70	15139.43
13	0	26744.00	26744.00	2000.00	26744.00	64560.00	110.69	2679.80	67239.80	57153.83	30409.83	0.23	13098.18	6129.03	6969.15	-15270.40
14	0	27487.00	27487.00	2400.00	27487.00	77472.00	115.50	2796.26	80268.26	68228.02	40741.02	0.20	13960.80	5624.38	8336.42	
15	0	29648.52	29648.52	2400.00	29648.52	77472.00	120.31	2912.71	80384.71	68327.00	38678.48	0.18	12483.09	5416.67	7066.41	0.50
16	0	30117.00	30117.00	2400.00	30117.00	77472.00	120.31	2912.71	80384.71	68327.00	38210.00	0.16	11145.61	4912.74	6232.88	
17	0	30117.00	30117.00	2200.00	30117.00	71016.00	210.31	5091.61	76107.61	64691.46	34574.46	0.15	9421.95	4386.37	5035.58	
18	0	30775.40	30775.40	2140.00	30775.40	69079.20	113.75	2753.89	71833.09	61058.12	30282.72	0.13	7939.97	4002.02	3937.95	
19	0	25393.24	25393.24	2000.00	25393.24	64560.00	113.75	2753.89	67313.89	57216.80	31823.56	0.12	6643.26	2948.33	3694.93	
20	0	29902.05	29902.05	1755.00	29902.05	56651.40	113.75	2753.89	59405.29	50494.49	20592.44	0.10	5234.60	3099.85	2134.75	
21	0	29626.56	29626.56	1572.00	29626.56	50744.16	113.75	2753.89	53498.05	45473.34	15846.78	0.09	4208.99	2742.22	1466.77	
22	0	47766.00	47766.00	1881.00	47766.00	60718.68	122.50	2965.73	63684.41	54131.74	6365.74	0.08	4473.58	3947.50	526.08	
23	0	53909.47	53909.47	1720.00	53909.47	55521.60	136.00	3292.56	177814.16	151142.04	97232.57	0.07	11152.46	3977.87	7174.59	
													164801.52	147316.22	17485.30	

BCR	1.119	NPV =	17485.3
IRR =	15%	PBP	13 years

PRODUCTION AND TRADE COMPETITIVE ADVANTAGES OF NATURAL RUBBER IN INDIA

By
PRADEEP. U.

ABSTRACT OF THE THESIS

Submitted in partial fulfillment of the
requirement for the degree of

Master of Science in Agriculture

(AGRICULTURAL ECONOMICS)

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ABSTRACT

The study entitled Production and Trade Competitive Advantages of Natural Rubber In India" was undertaken with the specific objective of examining the emerging trends in production, consumption, export and import of NR and the to assess the competitive advantages an disadvantages in the specific context of WTO regime. The study was conducted in the year 2001-03, using both primary and secondary data.

The trend analysis using different functional forms revealed that a growth functional form was the best fit for tapped area, production and yield of natural rubber whereas the exponential function turned out to be best fit for consumption of natural rubber. An analysis of the composition pattern revealed that natural rubber is slowly replacing the synthetic rubber in the world as well as in the Indian market.

The growth rate analysis of the area, tapped area, production and yield of natural rubber and reclaimed rubber revealed that their growth was highest during the sixties. It declined substantially thereafter.

More instability was experienced in the production of natural rubber during the eighties and the nineties. The decomposition analysis revealed that the price effect was a major contributing factor in the growth of natural rubber output in India.

There was considerable production advantage for NR producers in India with the average market price being consistently higher than the cost of production. There was no comparative advantage for natural rubber production in India for international trade as revealed by the domestic resource cost ratio. The Nominal Protection Coefficients indicated that Indian natural rubber was not enjoying trade competitive advantage in the international market.

The bound rate for natural rubber is now fixed at 25 per cent instead of 100 per cent for primary agricultural commodities because it is classified as an 'industrial raw material" under the WTO agreements. No "surge in imports" consequent to the removal of quantitative restrictions in natural rubber was

observed. The import as percentage to domestic production was declining over the years. The export subsidy-limiting provisions are not applicable for India till the exports reached 3.25 per cent of the world trade. However, in order to play any significant role in the international market, Indian natural rubber will have to be more competitive.