To study the trend in the production of Indian natural rubber by employing Nerlove's supply response theorem

Dr. Shyju Mathew

Faculty (visiting) in Economics, National Institute of Commerce and Technology,

Thrissur 680519, Kerala.

Abstract

The study tries to examine the trends in the production of natural rubber in India. The entire production of natural rubberas well as state-wise production is also analysed. The impact of supply response on production is explored by using Nerlove's model. A declining trend was evident in the production of India's natural rubber during the period 1986 and 2016. In the case of state wise production too, the diminishing trend is witnessed including Kerala which produces 78% of its total production. An increase in the previous production level positively influenced the current level of production. At the same time, an increase in previous price negatively impacted the current production level.

Keywords: Production, Nerlove's Model

1.Introduction

India ranks the sixth position in the production of world natural rubber. During 2014-15, the country produced 645,000 tonnes of natural rubber. However, in 2015-16, it was decreased to 562,000 tonnes of natural rubber (12.9%). Price volatility, weather adversity, high wages and lack of skilled tappers are some of the reasons for the shrinkage in the production of natural rubber (The Statistics and Planning Department, 2016). The traditional region contributed 82.4% of the total production during 2015-16. The north-eastern area among the non-traditional region accounted for 11.9% of the total outcome. According to sector classification, the smallholdings produced 91.6% of total production, and the estate sector produces the rest. Among the state-wise production, Kerala has generated 78% of its total outcome and 95.7% among the traditional region. The primary forms of natural rubber are sheet rubber, block rubber, concentrated latex and others include various grades of creped rubber. Among the different forms of rubber, solid block rubber contributes the central portion (75.1%), and RSS Grades provide 23% of natural rubber. (The Statistics and Planning Department, 2017).

2.Literature Review

George and Chandrashekar (2014) carried out a study to identify the growth and trend in production and marketing of natural rubber in Kerala. The objective of the study was (a) to analyse the growth in the area, production and productivity of natural rubber in Kerala, (b) to examine the marketing of natural rubber by different levels of producers in Kerala, (c) to examine the degree and direction of export of natural rubber from India. For analysing the growth in the area, production and productivity secondary data from 2000-01 to 2011-12 was used. Compound Annual Growth Rate Method (CAGR) was applied for measuring the growth trend in the area, production and productivity. The CAGR for growth in the area under rubber cultivation for Kerala was 1.309 per cent and for India was 2.576 per cent. CAGR for natural rubber production in Kerala was 3.097 per cent, and for India, CAGR was 3.491 per cent. CAGR for the productivity of natural rubber in Kerala was 1.75 per cent, and in India, it is 1.592 per cent. The world-wide CAGR for rubber production was 4.08 per cent.

Karunakaran (2017), examined the trend and determinants of rubber cultivation in Kerala and also analyse the trend in the volatility of rubber prices in Kerala. The analysis revealed that over the years, rubber cultivation became the most preferred agricultural activity in Kerala as compared to other agricultural activities. The area of rubber cultivation in Kerala increased from 123 hectares in 1960-61 to 550 hectares in 2014-15. The analysis also revealed that the production of natural rubber increased from 23 tonnes in 1960-61 to 508 tonnes in 2014-15. The tremendous increase was observed in the productivity of natural rubber, and it showed an increase from 187 in 1960-61 to 9232013 in 2014-15. However, the productivity growth showed a sharp decline in 2013-14 due to fall in rubber prices, and it fell from 1222 in 2000-01 to 1182 in 2013-14. The compound growth rate of the area, production and productivity of rubber in Kerala was 3.29, 7.07 and 3.90 respectively.

Vinitha and Ramalingam (2017), intending to understand the world-wide scenario of production and consumption of rubber, annual world-wide growth trend of rubber production and to analyse the production and consumption trend of rubber in India carried out a study. The study revealed that the worldwide production of rubber showed an increase of 1.6 per cent and reached a level of production of 12,314 tonnes in 2015 as compared to 12,115 tonnes in 2014.

The production trend of natural rubber in India from 2004-05 to 2015-16 showed both upward and downward movements and showed a CGR of negative 2.84 per cent. The production of natural rubber was 7,49,665 tonnes in 2004-05 and was 9,13,700 tonnes in 2012-13 and showed a positive growth rate except in 2007-08 and 2009-10. Heavy fall in production of rubber happened

in 2013-14 to 2015-16. The consumption of rubber from 2004-05 to 2015-16 showed an increasing trend and showed a CGR of 2.79 per cent.

3.Objectives

1. To examine the trend in the production of Indian natural rubber
2. To explore the impact of supply response on natural rubber by using Nerlove's Model

4.Materials and Methods

The current paper is analytical and it is based on secondary data. The data were obtained from The Indian Rubber Statistics (IRS) published by The Statistics and Planning Department, The Rubber Board. The data released by The Rubber Board during the period 1986-2016 were collected and examined for finding the objectives of the study. The trend in the production of Indian natural rubber was studied. To analyse the implication of supply response on production, Nerlove's model is used for the study.

5.Results and Discussion

Analysis of trend in production

For studying the trend in production, the annual growth rate and phase growth rate of the total production, production in the traditional and non-traditional region, state-wise production and type-wise production during the period 1986-2016 were analysed. This period was divided into six phases consisting of five years in each phase.

Total Production

Table.1 depicts the entire production of Indian natural rubber during 1986-2016. The production of natural rubber showed a declining trend throughout the period (figure.1). During 1989-1990, the rate of growth of production reached its highest level, i.e., 14.71% among the periods. During 2014-2015, the production steeply reached negative growth, i.e., -16.67% in the study period. While going through the different phases, the first phase showed the highest growth rate and the sixth phase depicted the lowest level with a negative growth rate. In the first phase (1986-1991), the growth rate reached 50.15% with an average annual growth of 10.73%. In the second phase (1991-1996), the growth rate declined to 38.21% compared to the first phase. The average rate of growth during this period was 9%. The third phase (1996-2001) showed a diminishing trend again. The rate of growth was 14.74% with an average annual growth of 4.49%. In the fourth phase (2001-2006), the rate of production growth increased to 27.12% with an average of 5%. During 2006-2011 (fifth phase), the rate of growth tremendously diminished to 1.06% with an average annual growth of 1.52%. In the sixth phase (2011-2016), the growth rate of production became highly negative, i.e., -37.81% and the average growth rate also declined to -7.77%.

Table.1:Total Production

Year	Phase	Total Production	Annual Growth rate	Growth rate (phase)
1986-87	I	219520		50.15
1987-88		235197	7.14	
1988-89		259172	10.19	
1989-90		297300	14.71	
1990-91		329615	10.87	
1991-92	II	366745	11.26	38.22
1992-93		393490	7.293	
1993-94		435160	10.59	
1994-95		471815	8.42	
1995-96		506910	7.44	
1996-97	III	549425	8.39	14.74
1997-98		583830	6.26	
1998-99		605045	3.63	
1999-00		622265	2.85	
2000-01		630405	1.31	
2001-02	IV	631400	0.16	27.12
2002-03		649435	2.86	
2003-04		711650	9.58	

2004-05		749665	5.34	
2005-06		802625	7.06	
2006-07	V	852895	6.26	1.06
2007-08		825345	-3.23	
2008-09		864500	4.74	
2009-10		831400	-3.83	
2010-11		861950	3.67	
2011-12	VI	903700	4.84	-37.81
2012-13		913700	1.11	
2013-14		774000	-15.29	
2014-15		645000	-16.67	
2015-16		562000	-12.87	

Source: Indian Rubber Statistics, The Rubber Board (Ministry of Commerce and Industry, Government of India)

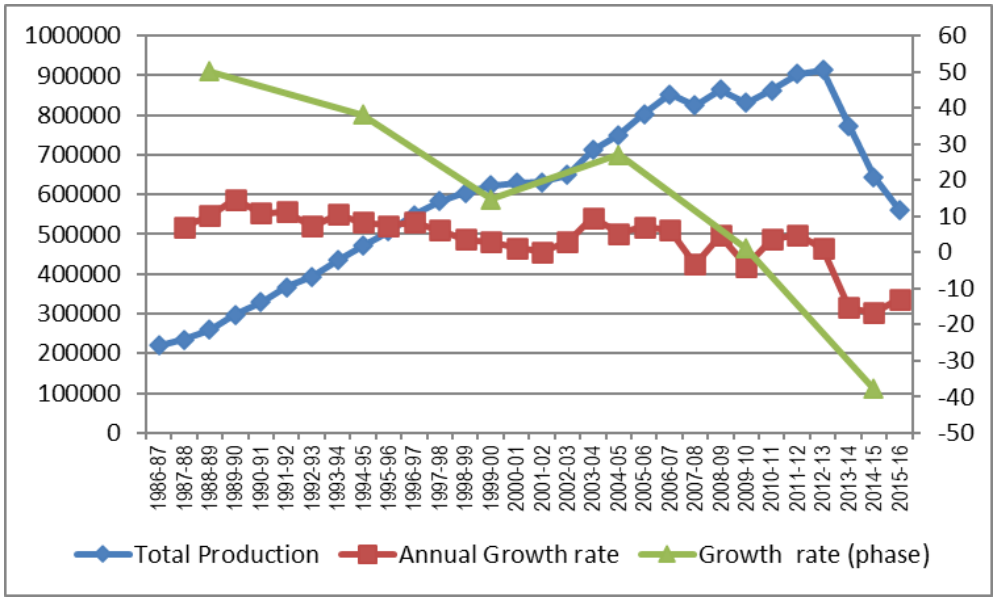

Fig.1: Total Production, Annual Growth rate and Phased Growth rate of NR

The decreasing trend witnessed in total production may be because of high volatility and fall in price. The expensive labour cost may be the other factor. The price fall compelled the cultivators to shorten the expenses on farming operations. The stoppage of practices to control weeds, the entire curtailment of practices like spraying pesticides to prevent the diseases of rubber trees are some of the measures taken by farmers to manage the fall in the price of natural rubber. The reduction in tapping days forced the tappers to stop tapping and decided to go for some other options for their livelihood (Mohankumar and Chandy, 2009). The stoppage of tapping and reluctance in providing fertilizers with the response to price fall may be the factors that led to the declining of the growth of Indian natural rubber production. (Mohankumar and Chandy, 2005).

State-wise production of Indian natural rubber

Production -Kerala

Table.2 examines the distribution of the production of Kerala. The state of Kerala holds a significant share of production. During 2015-16, Kerala occupied 78.05% of the total share of production. However, during 2000-2001, Kerala had a share of 91.98% of the entire production. The state of Kerala followed a decreasing trend during 1986-2016. The highest rate of growth in Kerala is evident in 1989-1990. The rate of growth during this period is 15.51%. The lowest rate of growth can be witnessed in 2014-2015. During this period, the growth rate was -21.68%. The first phase (1986-1991) of Kerala showed the highest rate of growth, i.e., 52.14% and the average growth rate was 11.10%. In the second phase (1991-1996), the growth rate decreased to 38.31% compared to the first phase. The average rate of growth during this period was 9.08%. The third phase (1996-2001) also showed a diminishing trend. The rate of growth was 13.09% with an average annual growth of 4.12%. In the fourth phase (2001-2006), the rate of production growth increased to 27.38% with an average of 5.03%. The fifth phase (2006-2011) depicted a negative phase. The rate of growth shrank to -1.62%, and the average annual growth was 0.93%. In the sixth phase (2011-2016), the growth rate became highly negative. The rate of growth decreased to -45.10% with an average annual growth of -10.09%.

Table.2:State-wise production- Kerala

Year	Phase	Production State-wise - Kerala	Annual Growth rate	Growth rate (phase)
1986-87	I	202129		52.14
1987-88		216562	7.14	
1988-89		238414	10.09	
1989-90		275397	15.51	
1990-91		307521	11.66	
1991-92	II	343109	11.57	38.31
1992-93		368648	7.44	
1993-94		408311	10.76	
1994-95		442830	8.45	
1995-96		474555	7.16	
1996-97	III	512756	8.05	13.09
1997-98		541935	5.69	
1998-99		559099	3.17	
1999-00		572820	2.45	
2000-01		579866	1.23	
2001-02	IV	580350	0.08	27.38
2002-03		594917	2.51	
2003-04		655135	10.12	
2004-05		690768	5.44	
2005-06		739225	7.01	
2006-07	V	783275	5.96	-1.62
2007-08		753135	-3.85	
2008-09		782685	3.92	
2009-10		745510	-4.75	
2010-11		770580	3.36	
2011-12	VI	798890	3.67	-45.10
2012-13		800050	0.15	
2013-14		648220	-18.98	
2014-15		507700	-21.68	
2015-16		438630	-13.60	

Source: Indian Rubber Statistics, The Rubber Board (Ministry of Commerce and Industry, Government of India)

Production – Tamil Nadu

Tamil Nadu is the second state that included in the traditional region (Table 3). A decreasing trend is evident in Tamil Nadu during 1986 -2016. The highest growth rate is evident in 1995-1996 period. During this period, the rate of growth was 15.07%. The rate of growth seems to be highly negative in 2015-2016, i.e., -18.04%. The second phase (1991-1996) showed the highest growth rate among the whole phases. The growth rate was highly negative in the sixth phase (2011-2016). During the first phase (1986-1991), the rate of growth in production was 16.08% with an average annual growth of 3.88%. In the second phase (1991-1996), the growth rate increased to 24.04%, and the average annual growth was 5.02%. During the third phase (1996-2001), the rate of growth declined to 16.78% with an average annual growth of 4.52%. In the fourth phase (2001-2006) the growth decreased to half of the previous rate, i.e., 8.8% with an average annual growth of 1.75%. The fifth phase (2006-2011) showed the growth rate of half of the previous phase, i.e., 4.75% with an average of 1.33%. In the sixth phase, the growth rate of production steeply declined to -22.70%, and the average annual growth rate was -4.70%.

Table 3:State-wise production-Tamil Nadu

Year	Phase	Production State-wise–Tamil Nadu	Annual Growth rate	Growth rate (phase)
1986-87	I	11755		16.08
1987-88		12470	6.08	
1988-89		13370	7.22	
1989-90		14065	5.20	
1990-91		13645	-2.99	
1991-92	II	13975	2.42	24.04
1992-93		14250	1.98	
1993-94		14720	3.30	
1994-95		15065	2.34	
1995-96		17335	15.07	
1996-97	III	18505	6.75	16.78
1997-98		19175	3.62	
1998-99		20263	5.67	
1999-00		21134	4.30	
2000-01		21611	2.26	
2001-02	IV	21631	0.09	8.89
2002-03		22253	2.88	
2003-04		22520	1.20	
2004-05		22690	0.75	
2005-06		23555	3.81	
2006-07	V	24020	1.97	4.75
2007-08		23850	-0.71	
2008-09		24355	2.12	
2009-10		24695	1.40	
2010-11		25160	1.88	
2011-12	VI	25220	0.24	-22.70
2012-13		25350	0.52	
2013-14		25000	-1.38	
2014-15		23785	-4.86	
2015-16		19495	-18.04	

Source: Indian Rubber Statistics, The Rubber Board (Ministry of Commerce and Industry, Government of India)

Production – Karnataka

Karnataka, one of the states among non-traditional region shows instability in the growth rate (Table 4). The highest rate of growth can be evident during1988-1989, i.e., 18.45% and the lowest growth rate can be seen in the period 2015-2016, i.e., -14.93%. While considering the various phases, the highest growth rate is evident in the fifth phase, and the lowest rate of growth is shown in the sixth phase. In the first phase (1986-1991), the rate of production growth was 37.28% with an average annual growth of 8.41%. In the second phase (1991-1996), the growth rate increased to 41.53%, and the average annual growth was 9.06%. During the third phase (1996-2001), the rate of growth decreased to 19.78% with an average annual growth of 5.44%. In the fourth phase (2001-2006) the growth decreased to nearly half of the previous rate, i.e., 10.95% with an average annual growth of 2.25%. In the fifth phase (2006-2011), the growth rate tremendously increased to 47.01% with an average of 9.78%. The sixth phase witnessed a diminishing trend. The growth rate of production steeply declined to 5.41%, and the average annual growth rate was 5.12%.

Table 4:State-wise production- Karnataka

Year	Phase	State-wise Production-Karnataka	Annual Growth rate	Growth rate (phase)
1986-87	I	4855		37.28
1987-88		5253	8.20	
1988-89		6222	18.45	
1989-90		6475	4.07	
1990-91		6665	2.93	
1991-92	II	7260	8.93	41.53
1992-93		7910	8.95	
1993-94		8626	9.05	
1994-95		9700	12.45	
1995-96		10275	5.93	
1996-97	III	11160	8.61	19.78
1997-98		12150	8.87	
1998-99		12549	3.28	
1999-00		13115	4.51	
2000-01		13368	1.93	
2001-02	IV	13465	0.73	10.95
2002-03		13659	1.44	
2003-04		14070	3.01	
2004-05		14440	2.63	
2005-06		14940	3.46	
2006-07	V	16125	7.93	47.01
2007-08		16450	2.02	
2008-09		19175	16.57	
2009-10		21331	11.24	
2010-11		23705	11.13	
2011-12	VI	27890	17.65	5.41
2012-13		31250	12.05	
2013-14		35230	12.74	
2014-15		34560	-1.90	
2015-16		29400	-14.93	

Source: Indian Rubber Statistics, The Rubber Board (Ministry of Commerce and Industry, Government of India)

Production – Andaman and others

Andaman and other states are included in the non-traditional region (Table 5). The significant share of this region stems from north-east states. The highest growth rate is evident during the period 1997-1998, i.e., 50.91%. The lowest rate of growth seemed to be negative, i.e., -5.67% during 2015-2016. While analysing the various phases, the first phase (1986-1991), showed the highest and the sixth phase (2011-2016) seemed to be the lowest rate of growth. In the first phase (1986-1991), the growth rate was 128.43%, with an average of 23.10%. In the second phase (1991-1996), the growth rate was declined to 97.63% with an average annual growth of 21.96%. The third phase (1996-2001), showed an increasing trend. During this period, the rate of

growth was accelerated to 122.16% with an average annual growth of 28.17%. In the fourth phase (2001-2006), the growth rate was steeply declined to 56.11%, and the average annual growth rate was 9.98%. In the fifth phase (2006-2011), the growth rate of production again declined to 44.21% with an average of 11.47%. The sixth phase (2011-2016) followed a similar trend and the rate of growth slightly decreased to 44.05%. The average annual rate of growth was 12.33% during this period.

Table 5:State-wise production –Andaman and other states

Year	**Phase**	**Production State-wise – Andaman and other states**	**Annual Growth rate**	**Growth rate (phase)**
1986-87	I	781		128.43
1987-88		912	16.77	
1988-89		1166	27.85	
1989-90		1363	16.90	
1990-91		1784	30.89	
1991-92	II	2401	34.59	97.63
1992-93		2682	11.70	
1993-94		3503	30.61	
1994-95		4220	20.47	
1995-96		4745	12.44	
1996-97	III	7004	47.61	122.16
1997-98		10570	50.91	
1998-99		13134	24.26	
1999-00		15196	15.70	
2000-01		15560	2.40	
2001-02	IV	15954	2.53	56.11
2002-03		18606	16.62	
2003-04		19925	7.09	
2004-05		21767	9.24	
2005-06		24905	14.42	
2006-07	V	29475	18.35	44.21
2007-08		31940	8.36	
2008-09		38285	19.87	
2009-10		39864	4.12	
2010-11		42505	6.63	
2011-12	VI	51700	21.63	44.05
2012-13		57050	10.35	
2013-14		65550	14.90	
2014-15		78955	20.45	
2015-16		74475	-5.67	

Source: Indian Rubber Statistics, The Rubber Board (Ministry of Commerce and Industry, Government of India)

The decreasing trend in state-wise production of natural rubber may be mainly because of the high volatility in the price of natural rubber. The reduction in the number of tapping days due to high labour cost forced the tappers to change their job to some other fields for their livelihoods. The lack of trained tappers and the stoppage of tapping led to a tremendous decrease in the growth rate of production. The reluctance in maintaining trees due to the high cost in fertilizers also severely affected the growth rate in the state-wise production of Indian natural rubber (Mohankumar and Chandy, 2005).

Analysis on supply response of Nerlovian model on area, production and productivity

For studying the supply response in the area, production and productivity of Indian natural rubber Nerlove's Supply Response Theory was based and for describing the same, multiple regression model was used.

Supply response analysis of Nerlove (1958) tradition was performed on output and tapped area administering the specification followed by (Soekartawi, 1983) assuming away the presence of surrogative for non-price factors.

Supply response of Nerlovian model on production

Production (Q_t) was regressed on the previous period price (P_{t-1}) and previous period production (Q_{t-1}).

$$Q_t = \delta_0 + \delta_1 P_{t-1} + \delta_2 Q_{t-1} + \varepsilon_t \quad (1)$$

The model was statistically significant ($p<0.01$). Unit increase in Q_{t-1} increased the production levels by 1.036 units ($p<0.01$) whereas unit increase in P_{t-1} reduced production levels by 5.97 units ($p=0.01$) (Table 6).

Table 6:Regression model of production: Model Summary

Dependent Variable: Q_t				
Method: Least Squares				
Sample (adjusted): 2 30				
Included observations: 29 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	30003.42	26537.11	1.130621	0.2685
P_{t-1}	-5.972269	2.202284	-2.711852	0.0117
Q_{t-1}	1.036034	0.057517	18.01257	0.0000
R-squared	0.959707	Mean dependent var		616056.5
Adjusted R-squared	0.956608	S.D. dependent var		204475.9
S.E. of regression	42593.97	Akaike info criterion		24.25451
Sum squared resid	4.72E+10	Schwarz criterion		24.39595
Log likelihood	-348.6904	Hannan-Quinn criter.		24.29881
F-statistic	309.6384	Durbin-Watson stat		1.239274
Prob(F-statistic)	0.000000			

6.Conclusion

The study examined the trend in production of natural rubber in India during 1986- 2016. A decreasing trend is evident in the total production of Indian natural rubber during the study period. Regarding state-wise production, Kerala followed a decreasing trend during 1986-2016 (78% of entire production). A decreasing trend is evident in Tamil Nadu (4% of total production). Karnataka, one of the states among non-traditional region shows instability in the growth rate (5% of total production).The decreasing trend is evident in Andaman and other states (13% of total production).A unit increase in previous production level increased current production levels by 1.036 units, whereas a unit increase in the previous price reduced production levelsby 5.97 units. This was indicative of the fact that favourable price movements have not been accompanied by better yields seldom leaving benefits for farmers.

References

1. **George, J. G., and Chandrashekar, H. M.** (2014). Growth and trend in production and marketing of natural rubber in Kerala, India.*International Journal of Current Research and Academic Review*, **2**(8), 53-61.
2. **Karunakaran, N.** (2017). Transformation of agriculture towards rubber cultivation in Kerala, its determinants and growth. *Indian Journal of Economics and Development*, **13**(2), 363-368.
3. **Mohankumar, S., and Chandy, B.** (2005). Investment and Employment in Rubber Small Holdings: Market Uncertainty in Reform Phase. *Economic and Political Weekly*, **40**(46), 4850-4856.
4. **Mohankumar, S., and Chandy, B.** (2009). Farm Price Volatility and its Impact onRuralLabourMarket Under Neo-Liberal Regime- AStudy of Rubber Tapping Labourer's in Kerala. *Journal of Rural Development*, **28**(2), 169-183.
5. **Nerlove, M.** (1958).Distributed Lags and Estimation of Long-run Supply and Demand Elasticities: Theoretical Considerations.*Journal of Farm Economics*, **40**(2), 301-311.
6. **Soekartawi.**(1983). Supply Response Analysis of Agricultural Production.*EKI*, **31**(4), 407- 417.

7. **The Statistics and Planning Department.** (2010). Indian Rubber Statistics.The Statistics and Planning Department. Kottayam: The Rubber Board.
8. **The Statistics and Planning Department.** (2016). Indian Rubber Statistics. Kottayam: The Rubber Board, Ministry of Commerce and Industry, Government of India.
9. **The Statistics and Planning Department.** (2017). Indian Rubber Statistics. Kottayam: The Rubber Board, Ministry of Commerce and Industry, Government of India.
10. **Vinitha, A. S., and Ramalingam, L. P.** (2017).Scenario of rubber production and consumption in India.*International Journal of Advance Research in Computer Science and Management Studies*, **5**(6), 34-39.