The trend in the tapped area of Indian natural rubber and its implication by employing Nerlove's supply response theorem

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Abstract

The study aims to analyse trends in the tapped area of natural rubber in India. The tapped area as a whole and state-wise in particular and also its implication by using the supply response model of Nerlove is examined. A diminishing trend was witnessed in the tapped area of Indian natural rubber during the period 1986 and 2016. Tapped area declined significantly for states like Kerala, Tamil Nadu and Andaman and other states while for Karnataka, the growth rate seemed to be volatile. The analysis based on supply response theory depicts that area amplified by 0.95 with a hectare growth in the previous area while a unit rise in the previous price impacted an increase in tapped area by 0.697.

Keywords: Tapped area, Nerlove's Model

1.　　　　Introduction

India ranks sixth in global position among the geographical area of natural rubber. India is comprised of 810800 hectares of the total area by which Kerala occupies 67.94% (550840 hectares) during the period 2015-16 (The Statistics and Planning Department, 2017). Traditional and non-traditional regions occupy the state-wise area of natural rubber. The traditional region includes Kerala and Tamil Nadu. Kerala is comprised of 96.5% of thetotal area among traditional areas. The non-traditional region includes northeastern states and other non-traditional areas. The north eastern states are comprised of Tripura, Assam, Meghalaya, Nagaland, Manipur, Mizoram and Arunachal Pradesh. Karnataka, Andaman and Nicobar Islands, Goa, Maharashtra, Odisha, West Bengal and Andhra Pradesh are the other non-traditional areas. The traditional region contributes 71.80% of the total area. The north-east region among the non-traditional area is comprised of 21.06% of the whole area. Based on cultivation, the area of natural rubber is divided into newly planted area, replanted area, tappable area and tapped area. 48.22% belong to the tapped area. Based on the holding structure, the area is divided into estates and smallholdings. The holdings include three sections namely 2 hectares and below, above 2 hectares and up to 4 hectares and above 4 hectares and up to 20 hectares. The estates are divided into five sections, i.e., above 20 hectares and up to 40, above 40 and up to 200 hectares, above 200 and up to 400 hectares, above 400 and up to 600 hectares and finally above 600 hectares. Among the total area, 91.17% is covered by the smallholdings, and the rest only stems from estates. (The Statistics and Planning Department, 2017).

2. Literature Review

Mani (1992), attempted to identify the nature, extent of government intervention for raising natural rubber production and productivity. The study also evaluated the effect of such Government interventions in making natural rubber as an import – substitute to synthetic rubber. A descriptive approach was adopted for explaining the Government intervention and secondary data relating to public sector agriculture in total GDP at factor cost, expenditure on commercial crop development, year-wise trend in new plantation areas and replanted area, fair price and market price of rubber are used for measuring the extent of Government intervention for raising natural rubber production and productivity.

George and Sethuraj (1996) tried to list the main characteristics of the world natural rubber economy, which is in a transition phase. They also identified the priorities and strategies relevant to India in the new economic scenario. The cardinal feature of world natural rubber production is a high degree of regional and structural concentration. Considerable variations exist among significant rubber-producing countries across the world concerning the priorities attached to net income increasing effect of and cost-saving efforts.

Chawla and Jha (2009) to forecast the production of natural rubber for each month of the years from 2006 to 2008 applied various forecasting techniques. They also identified the best forecasting technique using the Mean Absolute Percentage Error Method (MAPE). For forecasting, the production of natural rubber data on natural rubber production from January 1991 to December 2005 was used.

3. Objectives

1. To examine the trends in the area of natural rubber

2. To analyse the supply response of area by Nerlovian Model

4. Materials and Methods

The study is based on secondary data. The data regarding the area of Indian natural rubber is obtained from The Indian Rubber Statistics (IRS) published by The Statistics and Planning Department, The Rubber Board. For finding the objectives of the study, the data from 1986 to 2016 were analysed. This period consists of six phases with five years in each phase.

5. Results and Discussion

Analysis of trend in the area

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

Tapped area of Indian natural rubber

Table 1 analyses the tapped area of Indian natural rubber during 1986-2016. This thirty-year period witnessed a decreasing trend in the tapped area. During 1989-1990, the growth rate of the tapped area seems to be 8.63%. This is the highest rate of growth throughout the whole period. The lowest growth rate can be seen during 2015-2016, i.e., -12.51%. While analysing the six phases of the natural rubber, we can see a drastic reduction in the tapped area of natural rubber. During the first phase (1986-1991), the rate of growth of the tapped area was 29.25% which declined to -20.36% in the last phase (2011-2016). The first phase is the phase having the highest growth rate among the six phases. In the second phase (1991-1996), the rate of growth of the tapped area declined to 9.83% with an average growth rate of 3.08%. During the third phase (1996-2001), the rate of growth slightly decreased to 9.39% with an average of 2.33%. In the fourth phase (2001-2006), the growth rate of the tapped area increased to 11.55% with an average growth of 2.26%. The growth rate tremendously decreased to 5.11% in the fifth phase (2006-2011) with an average growth of 1.32%. The sixth phase showed a negative trend compared to the earlier phase. The growth rate of the tapped area decreased to -20.36%, with an average of -3.73%. When compared to the first phase, this phase follows a diminishing trend in the growth rate.

The decreasing trend in the tapped area may be due to the planters' decision to change the cropping pattern due to the heavy loss in rubber cultivation. During 2013-2014, the tappable area under rubber was 5,18100 hectares, but the area only tapped was 4,75200, i.e., 8.28% was not being tapped. During 2018- 2019, the difference in the growth rate of tappable and tapped was tremendously accelerated to 30%. The present executive director of the Rubber Board, Dr K N Raghavan after finding out the reason behind the decreased growth in the tapped area, i.e., fall in the price of domestic natural rubber due to heavy import, given instructions to adopt untapped area with the assistance of Rubber Producer's Societies (RPS). (The New Indian Express, 2019; The Hindu Business Line, 2019) The instability in the price and the high cost involved in the maintenance of natural rubber and the expensive labour may force the farmers to take such decisions (Varkey and Kumar, 2013).

Table 1:Tapped area

Year	Phase	Tapped area	Annual Growth rate	Growth rate (phase)
1986-87	I	237064		29.25
1987-88		249100	5.08	
1988-89		266103	6.83	
1989-90		289060	8.63	
1990-91		306413	6.00	
1991-92	II	324540	5.92	9.83
1992-93		330500	1.84	
1993-94		338550	2.44	
1994-95		346265	2.28	
1995-96		356444	2.94	
1996-97		365580	2.56	9.39
1997-98		376970	3.12	
1998-99		387100	2.69	
1999-00		394800	1.99	

Year	Phase	Tapped area	Annual Growth rate	Growth rate (phase)
2000-01	III	399901	1.29	
2001-02		400713	0.20	
2002-03		407953	1.81	
2003-04	IV	427935	4.90	11.55
2004-05		439720	2.75	
2005-06		447015	1.66	
2006-07		454020	1.57	
2007-08		458830	1.06	5.11
2008-09		463130	0.94	
2009-10	V	468480	1.16	
2010-11		477230	1.87	
2011-12		490970	2.88	
2012-13		504040	2.66	-20.36
2013-14		475200	-5.72	
2014-15	VI	446900	-5.96	
2015-16		391000	-12.51	

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

Tapped area – State wise

The statewise tapped area includes Kerala, Tamil Nadu, Karnataka, Andaman and other states including northeast region.

Tapped area- Kerala

Table 2 examines the distribution of the tapped area of Kerala during 1986-2016. The state of Kerala holds a significant share of the tapped area. During 2015-2016, 53.04% of the total share of the tapped area was occupied by Kerala. However, during the 2000-2001 period, Kerala possessed 89.97% of the total share of the tapped area. The state of Kerala showed a decreasing trend during 1986-2016. The highest rate of growth in Kerala was during the period 1989-1990, i.e., 8.94%. The lowest rate was during the period 2015-2016. During this period, the rate of growth of the tapped area declined to -13.90%. While analyzing the different phases, the first phase of Kerala 1986-1991 witnessed the highest rate of growth, i.e., 30.27% with an average annual growth rate of 6.84%. In the second phase (1991-1996), the rate of growth tremendously decreased to 9.11% with an average annual growth rate of 2.91%. In the third phase (1996-2001), a similar decreasing trend was followed. During this period, the rate of growth diminished to 7.27% with an average annual growth rate of 1.25. In the fourth phase (2001-2006), the growth rate slightly increased to 10.11% with an average annual growth rate of 1.82%. In the fifth phase (2006-2011) witnessed a declining trend. The growth rate steeply decreased to 1.69%, with an average annual growth rate of 0.50%. In the sixth phase (2011-2016), the rate of growth became negative, i.e., -28.33% and the average growth rate seems to be -5.90%.

Table 2:Tapped area State-wise - Kerala

Year	Phase	Tapped area State-wise - Kerala	Annual Growth rate	Growth rate (phase)
1986-87		218750		
1987-88		229940	5.12	
1988-89	I	246660	7.27	30.27
1989-90		268714	8.94	
1990-91		284960	6.05	
1991-92		301360	5.76	
1992-93		306539	1.72	
1993-94	II	313416	2.24	
1994-95		318965	1.77	9.11
1995-96		328812	3.09	
1996-97		335400	2.00	
1997-98		342420	2.09	

Year	Phase		Tapped area	Annual Growth rate	Growth rate (phase)
1998-99	III		349683	2.12	7.27
1999-00			355342	1.62	
2000-01			359780	1.25	
2001-02	IV		360006	0.06	10.11
2002-03			363791	1.05	
2003-04			381970	4.99	
2004-05			391397	2.47	
2005-06			396385	1.27	
2006-07	V		399635	0.81	1.69
2007-08			401420	0.45	
2008-09			401706	0.07	
2009-10			402740	0.26	
2010-11			406394	0.91	
2011-12	VI		413650	1.79	-28.33
2012-13			420520	1.66	
2013-14			382420	-9.06	
2014-15			344325	-9.96	
2015-16			296465	-13.90	

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

Tapped area- Tamil Nadu

Table 3 depicts the tapped area in Tamil Nadu. Tamil Nadu is one of the states in the traditional area of Indian natural rubber. A decreasing trend is seen in Tamil Nadu during 1986 to 2016. The highest growth rate was evident in 1987-1988, i.e., 5.27% and the rate of growth seems to be highly negative in 2015-2016, i.e., -12.35%. The first phase (1986-1991) showed the highest growth rate among the whole phases. During this period, the rate of growth was 8.23%, and the average annual growth rate was 2.02%. In the second phase (1991-1996), the growth rate tremendously decreased by 1.97% with an average rate of 0.92%. In the third phase (1996-2001), the rate of growth increased to 7.23% with an average annual rate of 1.91%. The fourth phase (2001-2006) saw a decreasing trend, i.e., 6.05% and an average growth rate was 1.22%. The rate of growth slightly decreased to 5.02% in the fifth phase (2006-2011) with an average of 1.19%. In the sixth phase (2011-2016), the rate of growth declined to negative. During this phase, the growth rate was -13.35%, with an average annual growth of -2.67%.

Table 3:Tapped area State-wise – Tamil Nadu

Year	Phase	Tapped area State-wise - Tamil Nadu	Annual Growth rate	Growth rate (phase)
1986-87	I	10970		8.23
1987-88		11549	5.28	
1988-89		11600	0.44	
1989-90		11835	2.03	
1990-91		11873	0.32	
1991-92	II	12180	2.59	1.97
1992-93		12110	-0.57	
1993-94		12215	0.87	
1994-95		12550	2.74	
1995-96		12420	-1.04	
1996-97		12730	2.50	
1997-98		13000	2.12	

1998-99		13215	1.65	
1999-00	III	13377	1.23	7.23
2000-01		13651	2.05	
2001-02		13677	0.19	
2002-03		14065	2.84	
2003-04	IV	14170	0.75	6.05
2004-05		14325	1.09	
2005-06		14505	1.26	
2006-07		14650	1.09	
2007-08		14730	0.55	
2008-09	V	15113	2.60	5.02
2009-10		15125	0.08	
2010-11		15385	1.72	
2011-12		15390	0.03	
2012-13		15460	0.45	
2013-14		15200	-1.68	
2014-15	VI	15310	0.72	-13.35
2015-16		13335	-12.90	

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

Tapped area- Karnataka

Karnataka is one of the states among the non-traditional region of the tapped area (Table 4). The instability in growth rate can be witnessed throughout the period. The highest rate of growth can be seen during 2013-2014, i.e., 12.56% and the lowest growth rate can be evident in 2015-2016, i.e., -13.94%. While considering the varied phases, the highest and the lowest growth rate is shown in the sixth phase. The first phase (1986-1991), showed the growth rate of 17.22% with an average of 4.07%. In the second phase (1991-1996), the growth rate increased to 29.31% and average growth of 6.51%. In the third phase (1996-2001), the rate of growth diminished to 13.15% with an average annual growth of 3.01%. During 2001-2006 (fourth phase), the rate of growth steeply declined to 5.81% with an average growth of 1.26%. In the fifth phase (2006-2011), the growth rate tremendously increased to 30.74% with an average of 6.69%. The sixth phase (2011-2016) witnessed the diminishing trend, and the rate of growth decreased to more than half of the previous period, i.e., 12.19%. The average rate of growth was 5.19%.

Table 4:Tapped area State-wise – Karnataka

Year	Phase	Tapped area State-wise - Karnataka	Annual Growth rate	Growth rate (phase)
1986-87		5935		
1987-88		6120	3.12	
1988-89	I	6281	2.63	17.2
1989-90		6500	3.49	
1990-91		6957	7.03	
1991-92		7370	5.94	
1992-93		7872	6.81	
1993-94	II	8410	6.83	29.31
1994-95		9175	9.09	
1995-96		9530	3.87	
1996-97		9760	2.41	
1997-98		10365	6.20	

Year	Phase			Growth rate
1998-99		10685	3.09	
1999-00		10980	2.76	13.15
2000-01	III	11043	0.57	
2001-02		11110	0.61	
2002-03		11278	1.51	
2003-04	IV	11488	1.86	
2004-05		11560	0.63	5.81
2005-06		11755	1.69	
2006-07		12414	5.61	
2007-08		12850	3.51	
2008-09		13635	6.11	
2009-10	V	14610	7.15	30.74
2010-11		16230	11.09	
2011-12		18165	11.92	
2012-13		20300	11.75	
2013-14		22850	12.56	
2014-15	VI	23680	3.63	12.19
2015-16		20380	-13.94	

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

Tapped area-Andaman and others

Andaman and others include northeast states, too (Table 5). The highest growth rate of the tapped area in this region is evident during the period 1997-1998, i.e., 45.45%. The lowest rate of growth seemed to be negative, i.e., -4.35% during 2015-2016. The third phase (1996-2001), showed the highest and the sixth phase (2011-2016) seemed to be the lowest rate of growth among the different phases. In the first phase (1986-1991), the growth rate was 86.16%, with an average of 17.44%. In the second phase (1991-1996), the growth rate was declined to 56.53% with an average annual growth of 17.38%. In the third phase (1996-2001), the rate of growth accelerated to 100.61% with an average annual growth of 23.10%. In the fourth phase (2001-2006), the growth rate was declined to 53.08%, and the average annual growth rate was 9.68%. In the fifth phase (2006-2011), the growth again declined to 43.56% with an average of 9.99%. The sixth phase (2011-2016) followed a similar trend, and the rate of growth decreased to 38.97%. The average annual rate of growth was 9.43%.

Table 5:Tapped area State-wise – Andaman and Others

Year	Phase	Tapped area State-wise-Andaman and Others	Annual Growth rate	Growth rate (phase)
1986-87		1409		
1987-88		1491	5.82	
1988-89	I	1562	4.76	86.16
1989-90		2011	28.75	
1990-91		2623	30.43	
1991-92		3630	38.40	
1992-93		3979	9.61	
1993-94	II	4509	13.32	56.53
1994-95		5580	23.75	
1995-96		5682	1.83	
1996-97		7690	35.34	
1997-98		11185	45.45	
1998-99		13517	20.85	

1999-00	III	15101	11.72	100.61
2000-01		15427	2.16	
2001-02	IV	15920	3.20	53.08
2002-03		18819	18.21	
2003-04		20307	7.91	
2004-05		22438	10.49	
2005-06		24370	8.61	
2006-07	V	27321	12.11	43.56
2007-08		29830	9.18	
2008-09		32676	9.54	
2009-10		36005	10.19	
2010-11		39221	8.93	
2011-12	VI	43765	11.59	38.97
2012-13		47760	9.13	
2013-14		54730	14.59	
2014-15		63585	16.18	
2015-16		60820	-4.35	

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

The decreasing trend in state wise tapped area of natural rubber may be mainly because of planter's shift in cropping pattern due to price volatility in natural rubber. The unexpected heavy loss from rubber cultivation, absence of trained tappers, high wages, increased rate in planting materials and the less encouragement from the Rubber Board may force the farmers to quit from the natural rubber cultivation (Chandy, George, and Raj, 2010).

Supply response of Nerlovian model on tapped area

Following Soekartawi (1983), tapped area (A_t) was regressed on previous period price (P_{t-1}) and previous period tapped area (A_{t-1})

$$A_t = \gamma_0 + \gamma_1 P_{t-1} + \gamma_2 A_{t-1} + \upsilon_t \qquad (1)$$

The model was statistically significant ($p<0.01$). A_t increased by 0.95 with unit increase in A_{t-1} ($p<0.01$) while a unit increase in P_{t-1} caused an increase in tapped area by 0.697 ($p=0.03$) (Table 6).

Table 6:Regression model of the tapped area: Model Summary

Dependent Variable: A_t				
Method: Least Squares				
Sample (adjusted): 2 30				
Included observations: 29 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24993.99	7233.832	3.455153	0.0019
P_{t-1}	0.697338	0.318883	2.186813	0.0379
A_{t-1}	0.953027	0.022242	42.84729	0.0000
R-squared	0.995625	Mean dependent var		406277.1
Adjusted R-squared	0.995289	S.D. dependent var		80939.32
S.E. of regression	5555.637	Akaike info criterion		20.18071
Sum squared resid	8.02E+08	Schwarz criterion		20.32216
Log likelihood	-289.6203	Hannan-Quinn criter.		20.22501
F-statistic	2958.526	Durbin-Watson stat		0.949937
Prob(F-statistic)	0.000000			

6. Conclusion

The study examined the trend in the tapped area of natural rubber in India during 1986- 2016. A declining trend was found in tapped area of natural rubber during the period. Tapped area declined substantially for states like Kerala(76% of the entire tapped area), Tamil Nadu (3% of the entire tapped area) and Andaman and other states (16% of the entire tapped area)while for Karnataka(5% of the entire tapped area) the growth rate for both the parameters has been volatile.The analysis based on supply response theory found that area increased by 0.95 with a hectare increase in the previous area while a unit increase in the previous price caused an increase in tapped area by 0.697.

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