Current Scenario of Sericulture Industry in Traditional Silk Producing States of India

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Abstract

The study concerned about the growth rate of mulberry area, production and productivity and cocoon and raw silk production and productivity five major traditional sates (Tamil Nadu, Karnataka, West Bengal, Andhra Pradesh, Jammu Kashmir and West Bengal) in India during 1980-81 to 2016-17. In Tamil Nadu, Compared with all the seven periods the highest significant compound growth observed in mulberry area and production was 17.50 per cent, 21.02 per cent during the period IV (1998-99 to 2001-02) and mulberry productivity 2.63 per cent since improved mulberry varieties like S36 and MR2 was released during that period II (1988-89 to 1997-98). Overall period (1980-81 to 2016-17), the cocoon productivity (2.67%) was positively significant in Tamil Nadu. There was a positively significant growth rate of cocoon production and productivity in Karnataka, Andhra Pradesh and West Bengal. Even though there was negative significant growth in productivity (-7.62%), but the growth of production (0.51%) was non-significant in Jammu Kashmir. There is significant positive growth of production (2.33%) and productivity (2.96%) in India. In Tamil Nadu, Thegrowth rates of raw silk production (2.17%) and productivity (5.25%) was foundhighly significant during the overall Period (1980-81 to 2016-17). There was a highly significant growth rate of raw silk production and productivity in Karnataka, Andhra Pradesh, West Bengaland for India as a whole.In Jammu Kashmir; the growth rates of cocoon production alone (4.14%) were significant.

Keywords: mulberry, silkworm, area, production, productivity

Introduction

India is an agro based cottage industry producing all the four types of commercial silk production and unique characteristics which are suitable for marginal and small farmers are cultivation of mulberry and others host plant for wild silkworms. In five traditional states are vast mulberry silk production viz., Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal and Jammu Kashmir and other states producing negligible quantities of silk production. Karnataka

has the highest quantity of mulberry silk production compared to other producing states of India. But Tamil Nadu is in a top position in bivoltine silk production due to climatic conditions and farmers obtaining good knowledge on sericulture. India is the second largest raw silk production next China. India has a distinct advantage of practicing sericulture over the period of time, yielding a stream of about five to six crops as a result of its tropical climate. Sericulture is an income generation throughout the year of all the categories of farmers. India, vast items of exports viz. Raw silk, made-up and readymade garments, fabrics, scarves and saree are which account for about 91.52 per cent of the total silk goods exports of the country. Annual estimated mulberry raw silk production of 23450 MT and 7350 MT of non-mulberry silk production accounted for. India, maximum 70 per cent of mulberry production and remaining 30 percent of non-mulberry production was reported. Today, sericulture has changed into a seri-business and money multiplying activity. Sericulture comprises two categories viz. pre-cocoon and post cocoon activities. Pre-cocoon are restricted to mulberry cultivation, leaf production, silkworm rearing (early and late) and cocoon production. Further, post cocoons on silk reeling, twisting, dying and weaving. Sericulture is an anterior to posterior steadily rising on raw silk production every year significantly.

Materials and Methods

The study concerned about the growth rate of mulberry area, production and productivity and cocoon and raw silk production and productivity five major traditional sates in India during 1980-81 to 2016-17.For secondary data on mulberry area, production and productivity, cocoon and raw silk production and productivity in India and five major traditional states were collected from various sources such as

- Department of Sericulture and State Sericultural Research and Development Institute, Government of Andhra Pradesh, Tamil Nadu, Karnataka, West Bengal and Jammu and Kashmir.
- Central Sericultural Research and Training Institute (CSR&TI), Berhampore, Mysore and Pampore.
- Central Silk Board, Bangalore (Annual Reports, India Stat, Technical Reports, Journals, Personal collections *etc.*) CSB website.

- Deputy Director of Post Cocoon Technology, Salem and Assistant Director of Sericulture, Salem, Dharmapuri, Tiruppur, Dindigul, Krishnagiri and Coimbatore.
- Department of Statistics, Handlooms, Handicrafts, Textiles and Khadi Department, Tamil Nadu.

Several projects were implemented in the country for sericulture development; particularly bivoltine sericulture development had been given high priority in India. Further, the study period was divided into seven periods according to developmental activities comprising of I Period (1980-81 to 1987-88), II Period (1988-89 to 1997-98), III Period (1991-92 to 1996-97) IV Period (1997-98 to 2001-02), V (2002-03 to 2006-07), VI Period (2007-08 to 2010-11), VII Period (2011-2015) and over all Period (1980-81 to 2016-17).

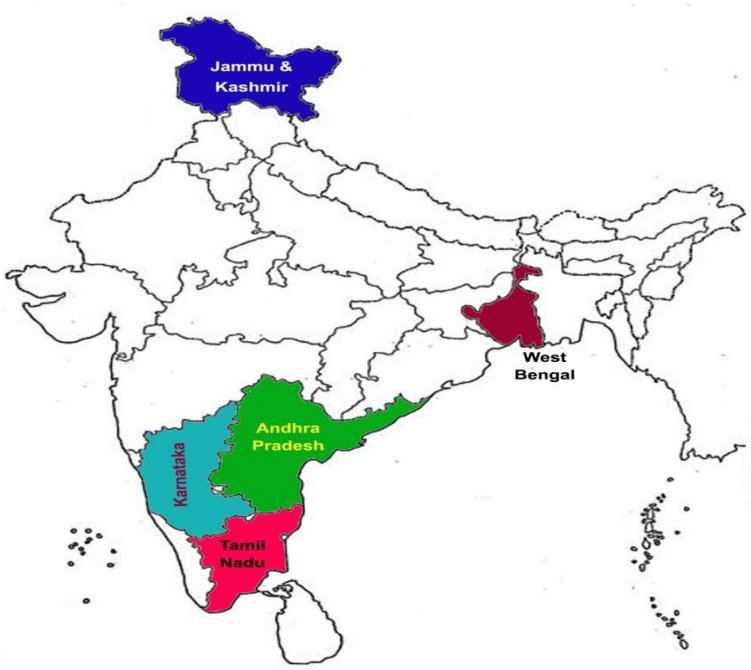
i. Period I: World Bank assisted Karnataka Sericulture Project (KSP) implemented in Karnataka State from 1980 - 88.
ii. Period II: World Bank assisted National Sericulture Project (NSP) implemented in 5 traditional states and pilot states from 1989 -98.
iii. Japanese government assisted JICA project in three phases from 1991 to 2007
iv. Period III: First phase (1991-97) – Development of basic Bivoltine Sericulture Technology Project.
v. Period IV: Second phase (1997-02) – Verified in Project of Promotion of Popularizing the Practical Bivoltine Sericulture Technology.
vi. Period V: Third phase (2002-07) – Expand Project for Strengthening Extension System (Institute- Village Linkage Programme) for bivoltine sericulture
vii. Period VI: Fourth phase (2007-11) - Project enhance sericulture employment generation and poverty improvement and women empowerment through capacity building. The programme envisages both horizontal expansion through raise area under mulberry cultivation and vertical raise by way of expansion in production, productivity and quality adopting cluster approach.
viii. Period VII: Fifth phase (2011-17) - Follow-up Cooperation Programme on JICA projects and catalytic development programme.

Tools of analysis

Current scenario of area, production and productivity under mulberry, cocoon and raw silk

The study period consists of 38 years from 1980-81 to 2016-17 for analyzing compound growth rate (CGR) of mulberry area, production and productivity and cocoon and raw silk production and productivity (Map 1)

Map 1: Major sericulture states covered for secondary data collection.



Compound growth rate

The growth rate in area, production and productivity of mulberry and cocoon and raw silk production and productivity were estimated using the exponential growth rate model in the form

$Y = a\, b^t\, e$ …… (3.1)

Whereas,

Y= Dependent variable (Area, Production and Productivity of mulberry and cocoon and raw silk production and productivity) for which compound growth rate was estimated

a= Intercept

b= Regression coefficient

t= Time variable

e= Error term

The Annual compound growth rate (CGR) was logarithmic form of the formula as below:

ln Y= ln a + t ln b…….(3.1)

The per cent annual compound growth rate (CGR) was derived using the equation g = (Anti logarithmic of b-1) x 100

A compound growth rate over the years was estimated using the 'b' coefficient. If coefficient was statistically significant and positive then growth rate of the estimated parameters over the years was accelerating. If it was negative, it was implied that, the growth rate was decelerating over the years.

3. Result and Discussion

3.1. Compound growth rate of mulberry area, production and productivity

The results of compound growth rate analysis for the mulberry in five traditional states from 1980-81 to 2016-17 is furnished in Table 1. In Tamil Nadu, Compared with all the seven periods the highest significant compound growth observed in mulberry area and production was 17.50 per cent, 21.02 per cent during the period IV 1998-99 to 2001-02, respectively.

The highest positive significant growth rate was observed in mulberry productivity 2.63 per cent since improved mulberry varieties like S36 and MR2 was released during that period II(1988-89 to 1997-98) which gave mean productivity of 45MT/ha/year and 35MT/ha/year, respectively (Bharat *et al.* 2014). Overall period (1980-81 to 2016-17) the highest positive compound growth rate observed in mulberry productivity was 3.19 per cent. Due to improved mulberry variety V1 and improved cultivation practices were released from CSR&TI, Mysore (Balavenkatasubbaiah, 2016).

The results of compound growth rate for the mulberry in Karnataka showed that positive growth rate was observed in mulberry area and production was 5.22 per cent and 7.11 per cent during the period VII(2011-12 to 2016-17), respectively. In mulberry productivity, highest growth rate observed was 8.19 per cent during the period VI(2007-08 to 2010-11). Overall period (1980-81 to 2016-17) the significant highest productivity growth rate recorded was 3.18 per cent.

Compound growth rate for the area, production and productivity of mulberry in Andhra Pradesh during 1980-81 to 2016-17, the significant and highest growth rate observed in mulberry area, production was 10.79 per cent, 15.66 per cent in 1980-81 to 1987-88, respectively. The 6.85 per cent was the highest compound growth rate recorded in mulberry productivity during the period V(2002-03 to 2006-07). For the overall Period (1980-81 to 2016- 17), even though the mulberry, production (3.11%), productivity (3.08 %) were highly significant, the growth of mulberry area (-0.07%) was non-significant.

In West Bengal during 1980-81 to 2016-17, positive and highest compound growth was recorded as 4.78 per cent in mulberry area during the period I (1980-81 to 1987-88) and 7.38 per cent in production during the period II(1988-89 to 1997-98). The highly significant and highest growth rate of 15.35 per cent was observed in mulberry productivity during the period VI(2007-08 to 2010-11). The analysis of CGR overall period (1980-81 to 2016-17) significant and highest growth rate was mulberry leaf production (4.02%) and productivity (3.75%), while growth of mulberry area (0.25%) was non- significant.

The positive significant and highest growth rate of mulberry area and production was 5.28 per cent, 7.62 per cent during the period III (1988-89 to 1997-98), respectively in Jammu Kashmir. Hence, the positively significant and highest growth rate in mulberry productivity was recorded with 15.98 per cent during the period VI (2007-08 to 2010-11). The analysis of pooled data (1980-81 to 2016-17) revealed that, there was a positively significant growth of mulberry area (8.81%), productivity (12.90%) and productivity (3.35%), respectively.

In India, highly significant and high growth rate was observed as 4.90 per cent in mulberry area during the period I (1980-81 to 1987-88). But the highest growth of mulberry leaf production (15.11%) and productivity (15.81%) during the period V (2002-03 to 2006-07). For the overall period (1980-81 to 2016-17) of mulberry growth of production (2.39 %) and productivity (3.04 %) was positively significant was observed. but, growth of mulberry area (-0.62%) was non-significant, respectively (Fig 1.1 to 1.3).

Table 1. Analysis of CGR of area, production and productivity components of mulberry for major States in India 1980-2017

Area in Ha; Production in MT; Productivity in Kg/ha

Details	Period I (1980-81 to 1987-88)		Period II (1988-89 to 1997-98)		Period III (1991-92 to 1996-97		Period IV (1998-99 to 2001-02)		Period V (2002-03 to 2006-07)		Period VI (2007-08 to 2010-11)		Period VII (2011-12 to 2016-17)		Overall period (1980-81 to 2016-17)	
States/ india	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**
Tamil Nadu																
Area)	9.91**	95.18	-14.56**	74.52	-19.30 **	75.93	17.50**	85.82	19.00 ^{NS}	30.27	0.77 ^{NS}	11.83	3.4 ^{NS}	36.28	-2.67**	25.60
Production	12.20**	97.30	-12.31**	67.64	-17.94**	72.94	21.02**	82.52	20.41**	67.53	12.08*	79.69	5.85**	61.14	0.44 ^{NS}	0.83
Productivity	2.08**	86.32	2.63**	54.63	2.16**	81.30	2.99^{NS}	60.00	1.18**	79.98	11.22*	87.09	2.36**	85.69	3.19**	96.70
Karnataka																
Area	3.00**	98.15	1.04^{NS}	20.48	1.91**	86.80	-6.06^{NS}	69.60	2.86 ^{NS}	24.36	-10.16 ^{NS}	76.04	5.22**	93.07	-1.91**	53.71
Production	8.71*	96.59	-15.09^{NS}	3.19	0.53 ^{NS}	13.74	-3.40^{NS}	-1.51	3.82 ^{NS}	58.28	-2.80 ^{NS}	10.56	7.11**	94.80	1.18**	43.89
Productivity	5.53**	92.55	-0.82^{NS}	6.40	1.51 ^{NS}	42.85	2.83**	88.89	0.92 ^{NS}	15.89	8.19**	89.53	1.79**	80.87	3.18**	86.01
Andhra Pradesh																
Area	10.79**	66.28	-8.79**	46.26	-2.02**	72.15	8.16**	99.96	-8.61**	74.26	0.46 ^{NS}	2.76	-5.12 ^{NS}	31.18	0.007 ^{NS}	0.79
Production	15.66**	80.86	-8.85**	53.80	-18.15**	68.33	12.09**	89.03	-2.35 ^{NS}	39.78	8.57 ^{NS}	59.97	-1.22 ^{NS}	2.10	3.11**	49.92
Productivity	4.38**	97.12	1.48**	79.45	2.22**	74.46	1.87^{NS}	45.94	6.85**	84.62	7.50 ^{NS}	78.11	4.11**	90.40	3.08**	94.91
West Bengal																
Area	4.78**	95.88	3.86**	91.08	2.83**	86.22	-5.55^{NS}	66.45	3.75**	99.60	-6.34 ^{NS}	58.55	3.05**	99.51	0.25 ^{NS}	1.76
Production	6.59**	91.52	7.38**	98.04	7.19**	94.23	-1.39^{NS}	19.18	5.19**	97.95	8.03**	99.26	6.44**	98.18	4.02**	84.31
Productivity	1.72**	64.08	3.38**	90.53	4.24**	82.93	4.39**	89.76	1.38**	79.98	15.35**	86.04	3.28**	92.15	3.75**	95.69
Jammu Kashmir																
Area	9.81*	46.36	16.48*	39.47	5.28**	85.89	2.77^{NS}	69.98	-7.64^{NS}	45.82	19.47^{NS}	63.33	2.61**	96.35	8.81**	82.30
Production	11.87*	51.34	22.47*	40.94	7.62**	85.89	4.03^{NS}	69.99	-4.24^{NS}	63.21	38.57^{NS}	78.80	6.95**	93.01	12.90**	79.63
Productivity	1.87*	52.58	5.14*	44.25	14.38**	83.68	1.23^{NS}	60.00	-0.89^{NS}	5.67	15.98**	89.57	4.22**	85.66	3.53**	90.27
India																
Area	4.90**	96.88	-0.54^{NS}	4.10	-4.15**	81.36	-4.91^{NS}	45.76	-0.60^{NS}	3.57	0.44^{NS}	8.77	2.52**	75.18	-0.62^{NS}	10.86
Production	8.51**	93.06	1.28^{NS}	27.71	1.35^{NS}	10.46	0.73^{NS}	2.34	15.11**	83.16	-1.93*	52.47	1.83NS	45.78	2.39**	78.69
Productivity	3.43**	65.44	1.84^{NS}	20.65	5.75**	60.72	5.93**	95.44	15.81**	79.98	-2.37*	60.00	-0.62NS	8.44	3.04**	74.08

****Significance at one per cent, *Significance at five per cent, NS-Non-significant**

(Figures in parentheses indicate percentages to total)

Fig 1.1 Mulberry area in India and five traditional sericulture states

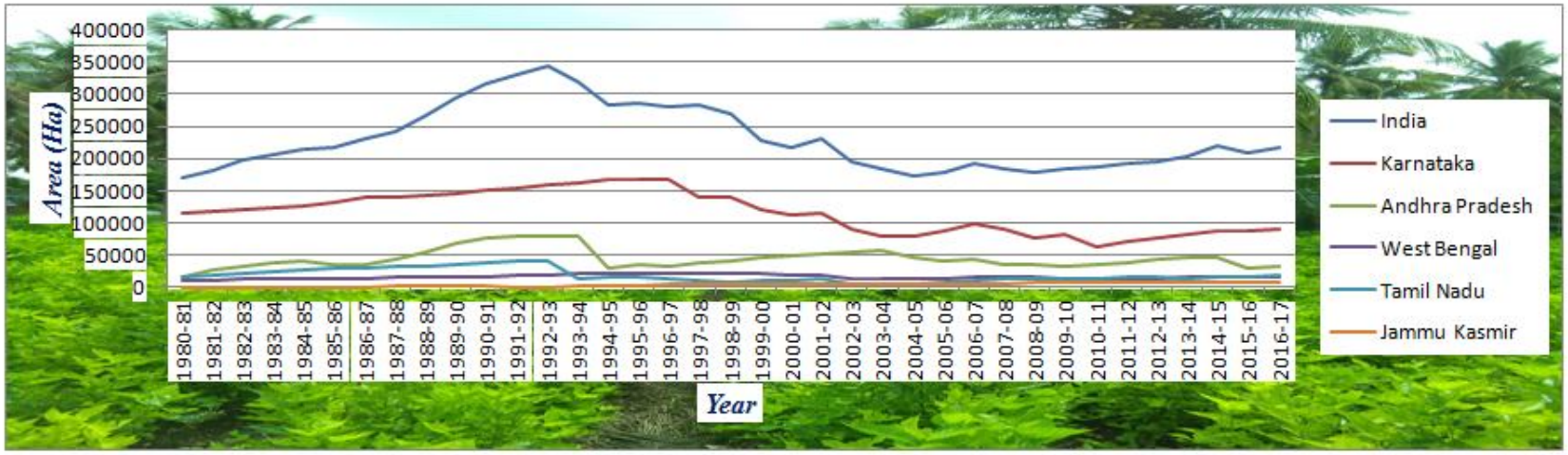


Fig 1.2. Mulberry production in India and five traditional sericulture states

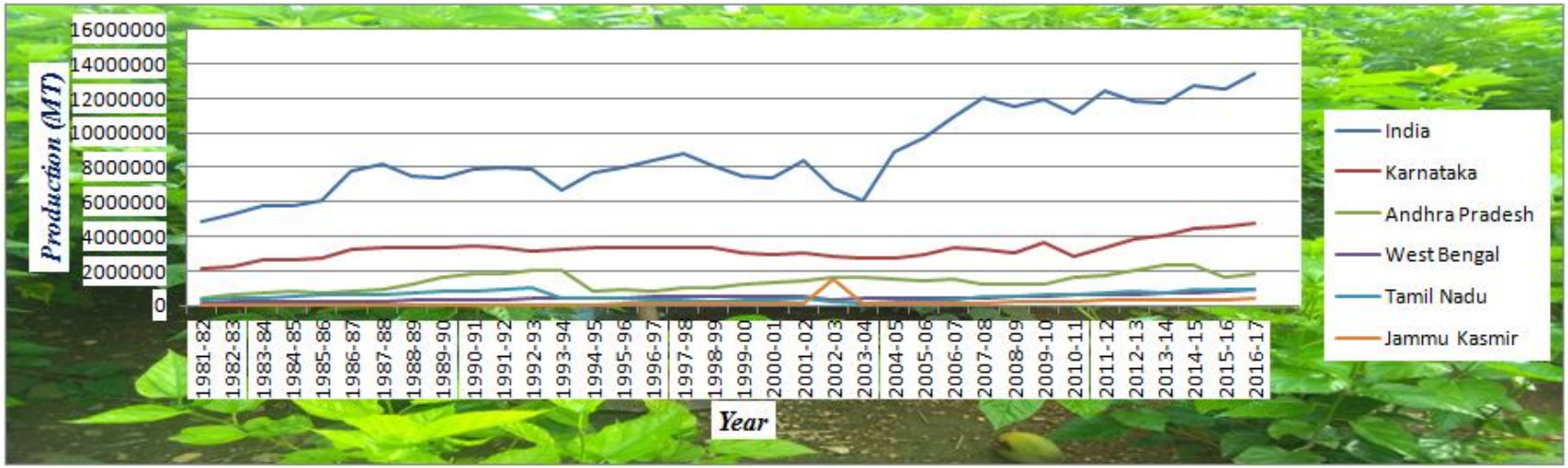


Fig 1.3. Mulberry productivity in India and five traditional sericulture states

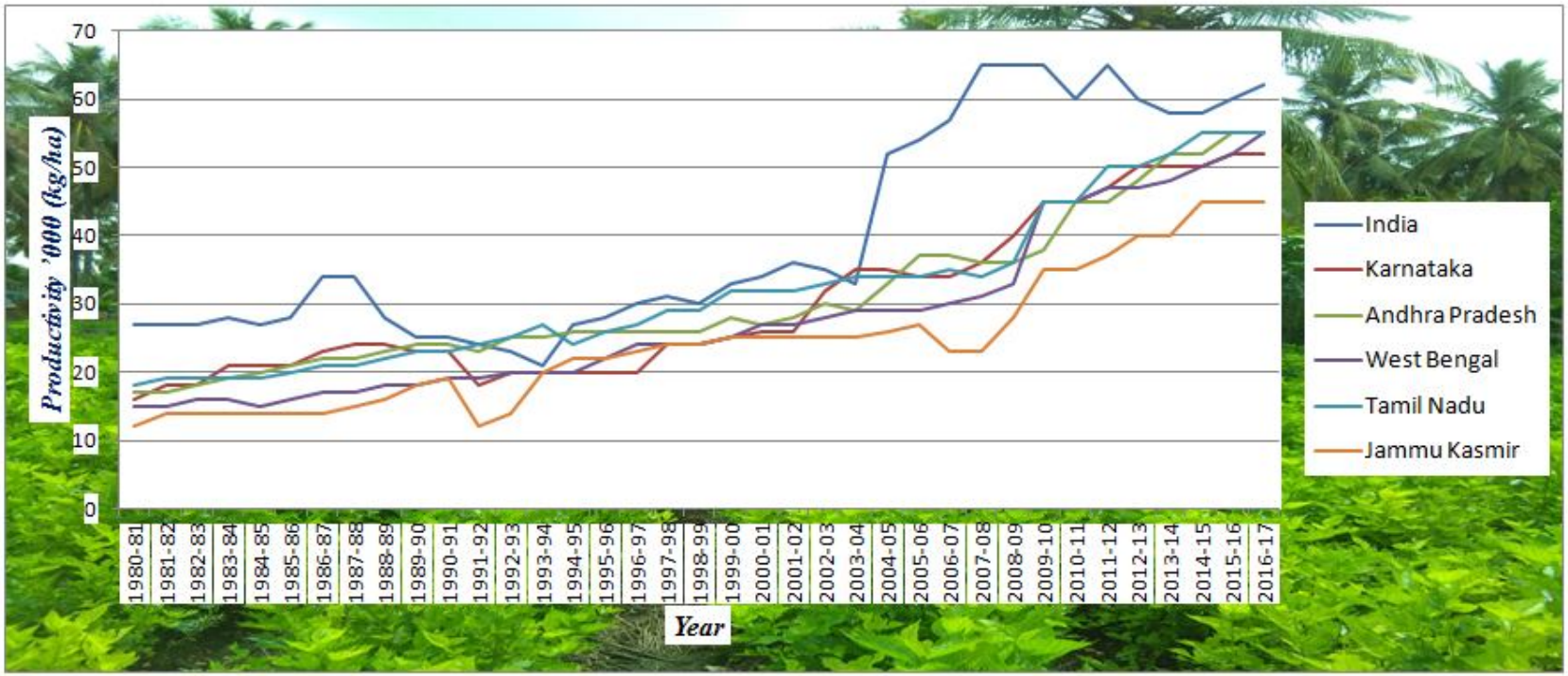


Table 2. Analysis of CGR of production and productivity of cocoon for major States in India 1980-2017

Production in MT; Productivity in Kg/ha

Details	Period I (1980-81 to 1987-88)		Period II (1988-89 to 1997-98)		Period III (1991-92 to 1996-97		Period IV (1998-99 to 2001-02		Period V (2002-03 to 2006-07)		Period VI (2007-08 to 2010-11)		Period VII (2011-12 to 2016-17)		Overall period (1980-81 to 2016-17)	
States/ india	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**
Tamil Nadu																
Production	6.98**	58.08	-5.34*	32.12	-9.81**	57.85	-1.54 NS	26.15	25.43	51.14	0.99 ^{NS}	1.38	10.31*	61.99	0.04 ^{NS}	0.01
Productivity	-2.64 ^{NS}	33.15	10.78**	92.07	11.75**	83.82	41.81**	99.24	5.15 ^{NS}	20.33	-5.38*	51.10	2.53**	56.13	2.76*	50.68
Karnataka																
Production	3.99**	81.36	4.84**	78.56	5.46*	52.62	-1.28NS	7.15	3.21 ^{NS}	22.46	-4.03 ^{NS}	65.78	2.60*	58.97	9.14**	20.35
Productivity	0.94 ^{NS}	18.93	3.74**	58.81	3.49*	37.02	5.10**	97.38	0.51 ^{NS}	2.71	-0.42 ^{NS}	7.94	0.06 ^{NS}	68.97	2.74**	91.20
Andhra Pradesh																
Production	15.80**	80.38	-2.60 ^{NS}	26.52	-6.70**	65.57	12.27**	99.67	-1.73 ^{NS}	17.77	0.76 ^{NS}	6.40	-5.44 ^{NS}	28.81	4.53**	71.49
Productivity	4.35*	46.72	6.76*	41.81	11.91**	48.94	2.80**	88.09	7.53**	90.90	-0.24 ^{NS}	1.47	-0.33 ^{NS}	10.19	4.5**	88.35
West Bengal																
Production	7.78**	94.42	1.81*	50.70	1.86**	38.26	1.53NS	4.09	1.70 ^{NS}	37.53	-1.96 ^{NS}	64.04	3.27**	95.34	2.71**	89.99
Productivity	2.71**	66.15	-1.66*	41.49	-1.59**	50.19	7.50*	64.48	-1.96 ^{NS}	50.11	4.65 ^{NS}	35.45	6.55**	90.25	2.46**	69.04
Jammu Kashmir																
Production	-4.71**	47.90	-1.09 ^{NS}	9.16 ^{NS}	-2.50 ^{NS}	20.71	-3.06NS	20.77	0.73 ^{NS}	1.47	2.47 ^{NS}	16.56	2.80*	44.48	0.51 ^{NS}	35.15
Productivity	-13.22**	65.82	-15.10*	39.87 ^{NS}	-37.21**	81.28	-5.86NS	46.18	9.19 ^{NS}	31.17	-14.20 ^{NS}	40.59	2.05*	61.25	-7.62**	74.88
India																
Production	6.37**	92.46	1.91**	44.03	0.30 ^{NS}	0.76	2.96*	47.90	1.82 ^{NS}	25.90	1.32 ^{NS}	24.34	2.52**	74.72	2.33**	78.84
Productivity	1.40*	49.89	2.04**	40.58	4.68**	65.65	9.01**	83.25	3.14*	73.65	0.86 ^{NS}	48.27	2.20**	93.68	2.96**	91.42

****Significance at one per cent, *Significance at five per cent, NS-Non-significant**

(Figures in parentheses indicate percentages to total)

Fig. 2.1: Cocoon production in India and five traditional sericulture states

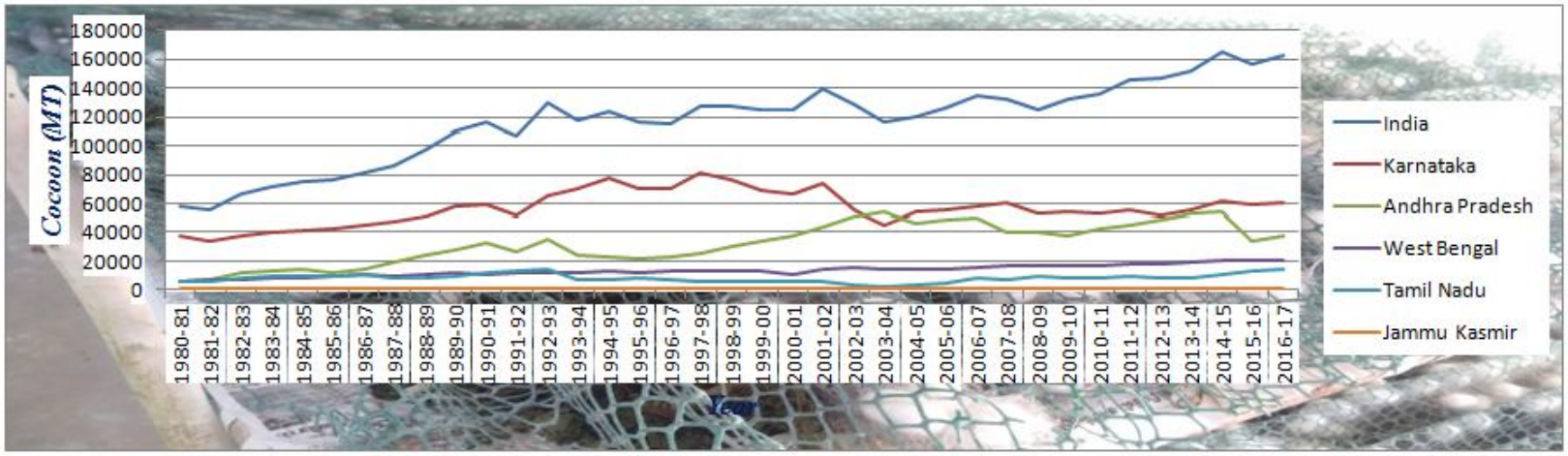


Fig. 2.2 : Cocoon productivity in India and five traditional sericulture states

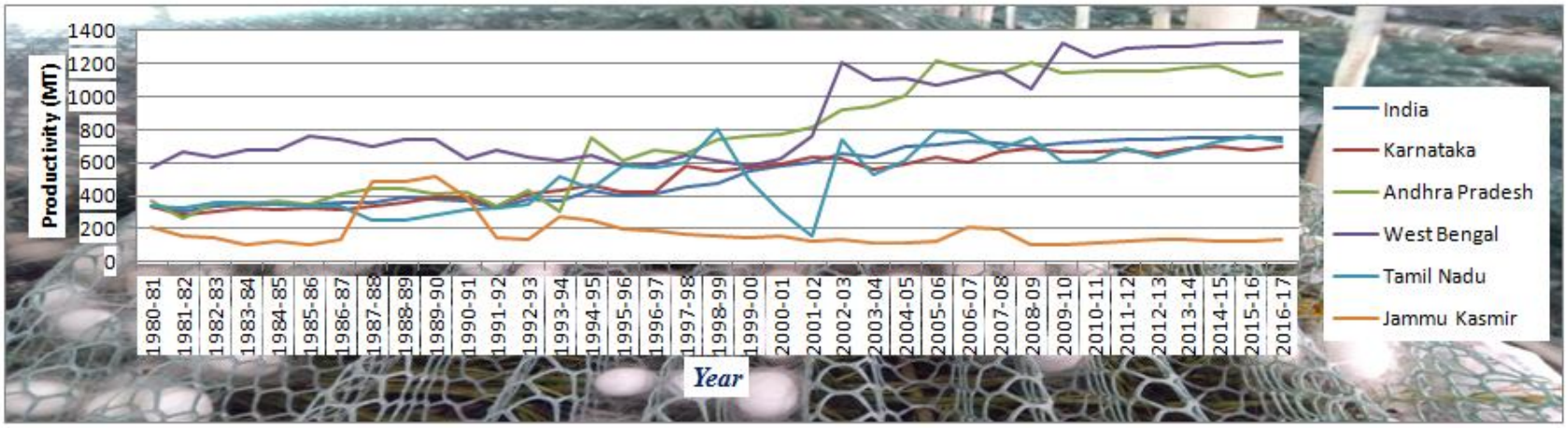


Table 3.Analysis of CGR of production and productivity components of raw silk

Production in MT; Productivity in Kg/ha

Details	Period I (1980-81 to 1987-88)		Period II (1988-89 to 1997-98)		Period III (1991-92 to 1996-97		Period IV (1998-99 to 2001-02		Period V (2002-03 to 2006-07)		Period VI (2007-08 to 2010-11)		Period VII (2011-12 to 2016-17)		Overall period (1980-81 to 2016-17)	
States/ India	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**	**CGR (%)**	**R^2 (%)**
Tamil Nadu																
Production	8.23**	70.38	-3.30 NS	17.54	-7.07*	47.39	0.79 NS	6.37	29.86*	62.63	-5.57	77.84	-8.93*	58.24	2.17**	29.23
Productivity	-1.59 NS	12.32	13.10**	91.06	15.07**	84.56	0.70 NS	0.09	8.90*	50.67	-5.10	50.01	4.44**	85.30	5.25**	86.99
Karnataka																
Production	8.50**	90.73	6.36**	82.57	7.70*	61.73	-0.63 NS	3.07	3.87**	98.52	-3.25	60.41	4.91**	86.05	2.49**	64.43
Productivity	5.13**	90.38	5.12**	72.45	5.68*	53.75	5.61**	97.20	2.55 NS	18.86	-0.43 NS	6.66	0.15 NS	10.15	4.05**	93.09
Andhra Pradesh																
Production	15.44**	89.99	-1.72 NS	19.43	4.95*	58.10	12.57**	99.84	-1.54 NS	14.83	5.67*	82.74	-3.38 NS	35.22	5.98**	82.68
Productivity	4.21 NS	10.42	7.70*	38.58	13.94*	47.33	3.07**	89.64	7.72**	83.87	4.26*	47.89	1.82 NS	14.41	5.78**	89.43
West Bengal																
Production	8.30**	69.11	4.28**	83.01	4.76**	77.33	5.09 NS	27.10	2.63**	95.39	4.20**	85.13	5.91**	86.08	4.07**	94.42
Productivity	3.27 NS	28.80	0.85 NS	15.11	1.33 NS	38.54	11.35**	75.10	1.14**	80.03	8.37**	82.07	2.97**	80.40	3.71**	80.11
Jammu Kashmir																
Production	-10.43**	73.25	18.67**	74.39	28.05**	73.36	-0.04 NS	0.003	9.19*	31.17	4.87**	74.90	0.04 NS	51.53	4.14**	58.35
Productivity	9.87 NS	10.39	1.88 NS	1.41	17.83**	90.64	-2.78 NS	12.63	9.20*	31.15	-12.39	39.31	0.021 NS	5.29	-2.68 NS	28.26
India																
Production	9.80**	97.87	3.61**	80.06	2.95*	42.98	3.52**	65.50	3.16**	71.57	0.65 NS	14.76	3.26**	82.07	3.66**	86.21
Productivity	4.58**	83.23	4.23**	71.85	7.49**	78.49	8.60**	87.06	4.53**	88.29	0.45 NS	80.00	1.04**	92.59	4.33**	95.56

****Significance at one per cent, *Significance at five per cent, NS-Non-significant**

(Figures in parentheses indicate percentages to total)

Fig. 3.1: Raw silk production in India and five traditional sericulture states

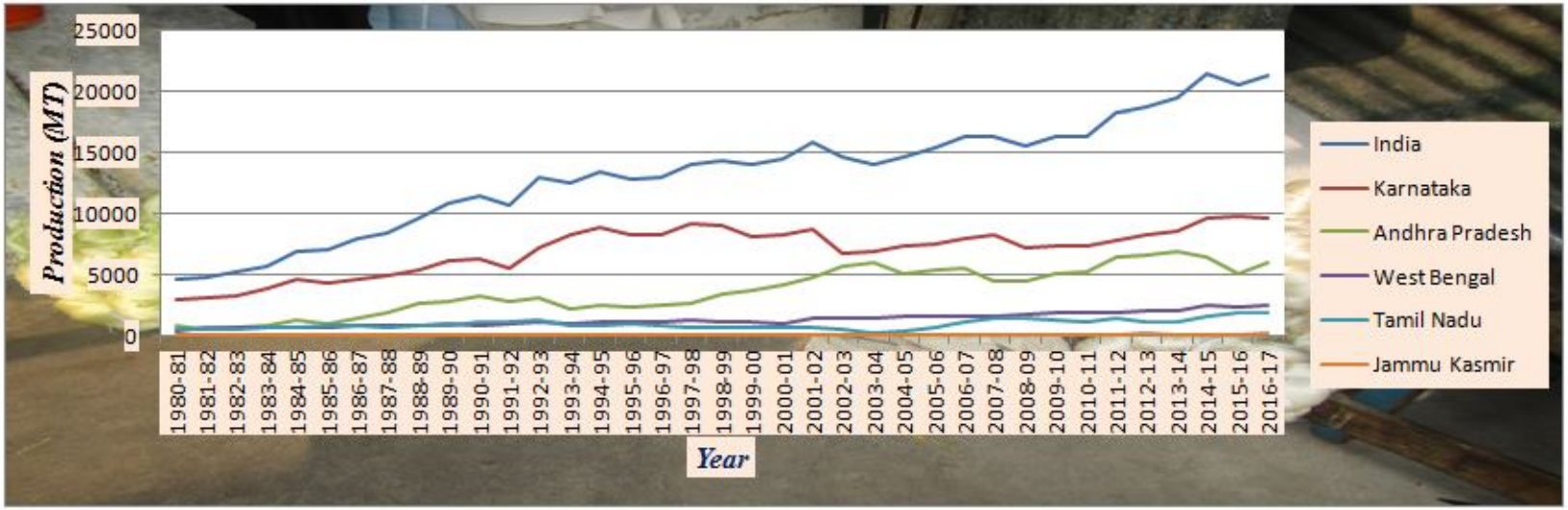
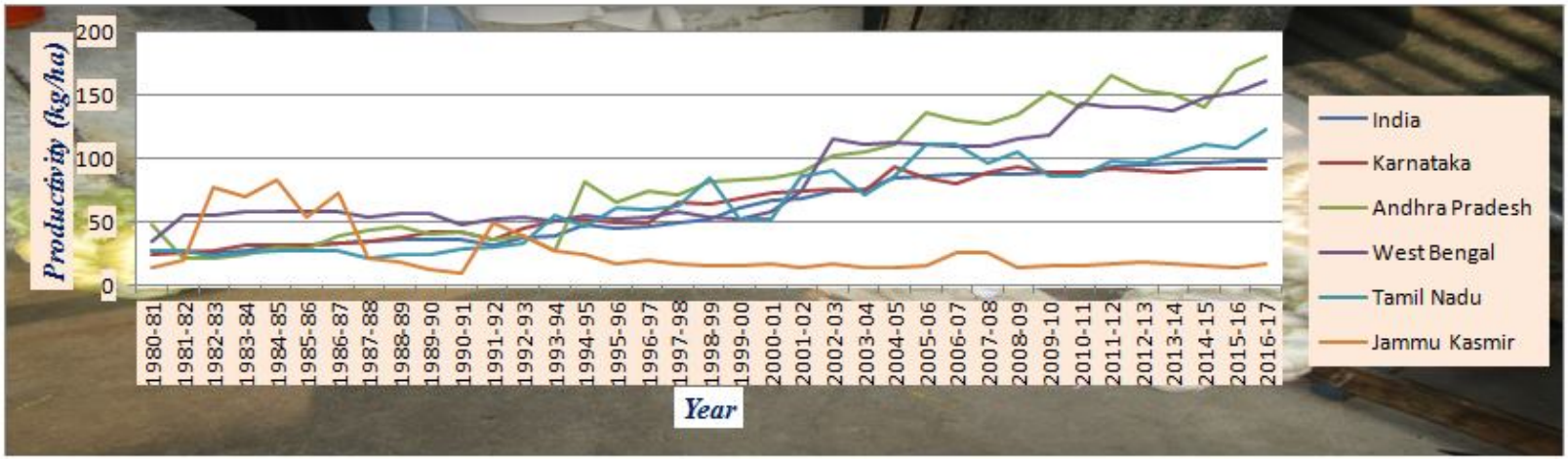


Fig. 3.2 : Raw silk productivity in India and five traditional sericulture states



3.2. Compound growth rate in cocoon production and productivity

The results of compound growth rate analysis for the cocoon production and productivity of Tamil Nadu from 1980-81 to 2016-17 is given by Table 2. The resulted indicated that highly significant and highest growth rate of cocoon production was 6.98 per cent during the period I (1980-81 to 1987-88). Positively significant and highest growth rate was recorded in cocoon productivity 41.81 per cent during the period IV (1998-99 to 2001-02). During that period IV (1998-99 to 2001-02) Japanese government assisted JICA project (Project on promotion of popularizing the practical bivoltine sericulture technology) (Dandin *et al*.2014) and due to improved silkworm rearing practices like robust silkworm hybrids namely, bivoltine hybrids like CSR2x CSR4, CSR4 x CSR5, CSR18 x CSR19, shoot rearing and mounting methods like Netrika, management of diseases, techniques of seed production, processing and incubation, Sampoorna (Phytoecdysteroid)were released from CSR&TI, Mysore (Balavenkatasubbaiah *et al.* 2016).

The farmers achieved up to 70 to 80 kg cocoon yield per 100 dfls. The raw silk reeled from these cocoons could get 2A grade (CSR&TI, Mysore). However, for the overall period (1980-81 to 2016-17), the cocoon productivity (2.67%) was positively significant, while the growth of production (0.04%) was non-significant.

The highest compound growth rate observed in cocoon production was 4.84 per cent during the period II (1988-89 to 1997-98) in Karnataka.During the period IV (1998-99 to 2001-02) positive significant and highest compound growth rate in cocoon productivity was 5.10 per cent. The analysis of pooled data in CGR of overall period (1980-81 to 2016-17) showed that positively significant growth rate of cocoon production (9.14%) and productivity (2.74%).

The result in Andhra Pradesh revealed that, the growth rate was positive significant and highest growth rate of cocoon production with 15.80 per cent in during the period I (1980-81 to 1987-88). While, highly significant and highest compound growth rate of 11.91 per cent was observed in cocoon productivity during the period III (1991-92 to 1996-97). For the overall period (1980-81 to 2016-17), the cocoon production (4.53%) and productivity (4.50%) was positive significant, respectively.

The highly significant and highest growth rate of cocoon production (7.78%) was during the period I (1980-81 to 1987-88) in West Bengal. But there was a significant and highest cocoon productivity of compound growth rate (6.55%) during the period VII (2010-11 to 2016-17). The overall period (1980-81 to 2016-17), positive significant growth found in production (2.71%) and productivity (2.46%), respectively.

The result indicated that, highest growth rate and significant cocoon production (2.80%) and productivity (2.05%) was found in Jammu and Kashmir during the period VII (2011-12 to 2016-17). During the overall period (1980-81 to 2016-17), though there was negative significant growth in productivity (-7.62%), but the growth of production (0.51%) was non-significant.

For India, positive significant and highest compound growth rate of cocoon production was 6.37 per cent during the period I (1980-81 to 1987-88). While, there was a positively significant and highest growth rate of cocoon productivity (9.01%) during the period IV (1998-99 to 2001-02). The CGR analysis of pooled data showed that there is significant positive growth of production (2.33%) and productivity (2.96%), respectively (Fig 2.1 to 2.2).

3.3. Compound growth rate in production and productivity of raw silk

The results of compound growth rate analysis for the raw silk production and productivity in five traditional states from 1980-81 to 2016-17 is furnished in Table 3. In Tamil Nadu, highest compound growth rate of raw silk production was 8.23 per cent in during the period I (1980-81 to 1987-88). Positive significant and highest growth rate of raw silk productivity was 15.07 per cent during the period III (1991-92 to 1996-97). The growth rates of raw silk production (2.17%) and productivity (5.25%) was found highly significant during the overall Period (1980-81 to 2016-17). Due to that period III (1991-92 to 1996-97), the JICA project implemented (Bivoltine Sericulture Technology Development Project) in major traditional raw silk producing states like Tamil Nadu, Karnataka and Andhra Pradesh and cocoon cooking methods, cocoon drying, cocoon quality testing, cocoon storage and improved reeling techniques (Multiend reeling) were released from CSR&TI, Mysore (Dandin *et al*.2014).

In Karnataka, positive significant and highest compound growth rate of raw silk production was 8.50 per cent during the period I (1980-81 to 1987-88). Highest growth rate and

significant raw silk productivity was 5.61 per cent during the period IV (1998-99 to 2001-02), respectively. The analysis of growth rate for the overall Period (1980-81 to 2016-17) revealed that, there was a highly significant growth rate of raw silk production (2.49%) and productivity (4.05%).

In Andhra Pradesh, highest compound growth rate of raw silk production was 15.44 per cent in during the period I (1980-81 to 1987-88). While, the highly significant and highest compound growth rate was observed in raw silk productivity 7.72 per cent during the period V (2002-03 to 2006-07). The analysis of growth rate for the overall period (1980-81 to 2016-17) revealed that, there was a positive significant growth rate of raw silk production (5.98%) and productivity (5.78%).

The result in West Bengal revealed that, the growth rate was positive significant and highest growth rate ofraw silk production 8.30 per cent during the period I (1980-81 to 1987-88). However, the positively significant and highest compound growth of raw silk productivity 11.35 per cent during the period IV (1998-99 to 2001-02). The analysis of growth rate for the overall Period (1980-81 to 2016-17) revealed that, there were highly significant growth rates of raw silk production (4.07%) and productivity (3.71%).

In Jammu and Kashmir**,**positive significant and highest CGR of raw silk production and productivity was 28.05 per cent and 17.83 per cent during the period III (1991-92 to 1996-97). The growth rates of mulberry raw production (4.14%) were significant and productivity (-2.68%) were non-significant during the overall study Period (1980-81 to 2016-17).

For India, highest compound growth rate of raw silk production and productivity was 9.80 per cent during the Period I (1980-81 to 1987-88) and 8.60 per cent during the period IV (1998-99 to 2001-02), respectively. During the overall Period (1980-81 to 2016-17), there was a positive significant growth rate of cocoon production (4.33%), and cocoon productivity (3.66%), respectively (Fig 3.1 to 3.2).

Conclusion

India five traditional silk producing states fulfill the demand of silk in all the states. Silk production is tremendously increased each year due to improved mulberry varieties and

silkworm races, recent agronomic practices, etc. despite the egg production Centre given the quality of disease-free laying. Apart from that, the central silk board is under research institution to develop several products such as micronutrient to raise on mulberry leaf yield and various disinfects both room and bed to reduce microorganism in silkworm rearing house. Finally, increase the mulberry cultivation and silk production to make steps in central silk boards to give training and demonstration to all the parts of villages.

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