

# Scenario of mulberry and cocoon production in major silk producing States of India- Application of exponential growth function

M. Manjunath<sup>1</sup>, K.C. Narayanaswamy<sup>2</sup>, Savithramma<sup>3</sup>, S. Harish babu<sup>4</sup>, H. V. Harishkumar\*<sup>5</sup>

<sup>1</sup> Extension Inspector, Coffee board, Kalasa, Chikkamagalur, Karnataka, 577124, India

<sup>2</sup> Professor, Department of Sericulture, UAS, GKVK, Bengaluru-560065, India

<sup>3</sup> Assistant manager, Vijaya Bank, hirebyle, Chikkamagalur, Karnataka, 577124, India

<sup>4</sup> Ph.D. Scholar, Department of Sericulture, UAS, GKVK, Bengaluru-560065, India

<sup>5</sup> Ph.D. Scholar, Department of Agricultural Economics, UAS, GKVK, Bengaluru-560065, India

ckbmanjuseri@gmail.com<sup>1</sup>, kcn\_uas@yahoo.co.in<sup>2</sup>, savithrimanju87@gmail.com<sup>3</sup>, harishbabuseri@gmail.com<sup>4</sup>, harishpal0083@gmail.com<sup>5</sup>

## Abstract

**Background/Objectives:** Sericulture is an important livelihood option for the farmers of Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu Kashmir, formally traditional sericulture states.

**Methods/Statistical analysis:** Data on mulberry area, production, productivity and cocoon production, productivity was collected for the period 1971-72 to 2008-09 and analyzed by break down of data into 4 equal periods of 10 years for knowing significant causes behind increase or decrease in the parameters studied using exponential growth rate.

**Findings:** All the traditional sericulture states, exhibited significant positive growth in the area under mulberry, production and productivity during the Period II. Karnataka (-0.14 %) and Tamil Nadu (-1.41 %) have exhibited negative growth rate with respect to area under mulberry cultivation during period 1971-72 to 2008-09 due to factors like acute water shortage, non-availability of labors, reduction of fertile land to real estate and volatile cocoon price and for the same period India has exhibited a significant and positive growth in area (1.65 %), production (4.05 %) and productivity (2.32 %). Karnataka, Andhra Pradesh and West Bengal have exhibited positive and significant growth in Cocoon production and productivity during study period. At national level Cocoon production (4.08 %) and productivity (2.41 %) have seen significantly positive trend during study period.

**Improvements/Applications:** The study highlights the need of sericulture friendly policy interventions in the traditional states especially Karnataka by assuring minimum price for Cocoon thereby reducing the volatility in the prices.

**Key words:** Exponential growth rate, Traditional states, Policy intervention, Sericulture, Livelihood

## 1. Introduction

Sericulture is one of the important sectors of economy in India and plays an important role in poverty alleviation. Compared to agricultural crops, sericulture provides more employment round the year and fetches higher income to the rural farm families. Sericulture has been an important income generating cottage based industry in the country. Sericulture industry has been providing sustainable income for different strata of people in the rural society including the landless.

The foreign exchange earnings from total silk exports and imports during the period 2010-11 were Rs. 2,867.52 Crores and Rs. 933.70 Crores, respectively. [1] The total area under mulberry cultivation was 1,83,773 ha during 2010-11 where in 82.77 % of which was spread among the traditional sericulture states like Karnataka (82,098 ha), Andhra Pradesh (36,384 ha), Tamil Nadu (14,220 ha), West Bengal (12,374 ha) and Jammu & Kashmir (7,063 ha) [2]

India's raw silk demand was around 26,000 MT but produces only 19,690 MT. So Indian sericulture does not meet country's demand; hence the shortage was met by importing 8,000-9,000 MT of raw silk from China and other countries such as Uzbekistan, Brazil, Japan, Korea RP and others (14).

Hence Sericulture is an important agro based cottage industry, occupies an important position in the Indian economy owing to its employment and revenue generation potential, also because of growing demand for silk in the domestic and overseas markets.

## 2. Materials and Methods

### 2.1 Data requirement

Time series data (secondary data) on Mulberry area, production, productivity and Cocoon production, productivity in India and the traditional sericulture states such as Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu & Kashmir were collected from sources *viz.*,

- Central Silk Board, Bangalore (Annual Reports, Technical Reports, Journals, Personal collections, *etc.*)-  
www.csb.gov.in
- Central Sericultural Research and Training Institute, Mysore, Karnataka
- Karnataka State Sericulture Research and Development Institute, Bangalore, Karnataka
- Department of Statistics, Government of Karnataka, Bangalore
- Department of Sericulture, Government of Karnataka, Bangalore
- www.indiastat.com

The data on said variables for the period 1971-72 to 2008-09 i.e. 38 years was used for estimating compound growth rate (CAGR) from exponential growth function. The study Period was divided into four period i.e. Period I (1971-72 to 1979-80), Period II (1980-81 to 1989-90), Period III (1991-92 to 1999-00), Period IV (2000-01 to 2008-09) for avoiding the long term variations and to capture short term variations.

### 2.2 Growth model

The growth in area, production, productivity of Mulberry and Cocoon production and productivity was analyzed using the exponential growth function. The form of function used is

$$Y = a b^t e$$

Where,

Y= Dependent variable for which growth rate is estimated

a = Intercept

b = Regression coefficient

t = Time variable

e = Error term

Since the model being the multiplicative the function was transformed into additive model by simple logarithmic transformation as below:

$$\ln Y = \ln a + t \ln b$$

The per cent compound growth rate (CAGR) was derived using following formulae

$$\text{CAGR} = (\text{Anti In of } b - 1) \times 100$$

Pattern of growth rates over the years was identified using the 'b' coefficient. If coefficient was statistically significant and positive then growth of the estimated parameters over the years was accelerating. If it was negative, it was implied that, growth was decelerating over the years. [3]

## 3. Results and Discussion

### 3.1. Karnataka

In Karnataka the CAGR of mulberry area (2.81%) and production (1.91%) during the Period I was significant and positive indicating the acceleration, whereas growth rate of productivity was not significant (Table 1). This demonstrates that the increase in production during the period was largely due to area expansion rather than the

growth in productivity of mulberry. During the Period II, there was significant and positive growth of mulberry area (2.78%), production (7.20%) and productivity (4.30%); this may be attributed to the introduction of Karnataka Sericulture Project under World Bank during the period. Mulberry growth rate of 2.32 per cent in Karnataka for a period of about two decades (1980-80 to 1997-98) [4]. The area under mulberry had a significant growth in Karnataka during 1961-62, 1971-72, 1981-82 and 1991-92 with 74,870, 94,349, 1, 19,838 and 1, 53,085 hectares, respectively [5].

During the Period III, the area under mulberry expansion was not significant and also showed negative growth trend (-1.85%) so as the production of mulberry (0.47%), which are attributed to occurrence of Pebrine disease of silkworm in the major sericulture belt during 1991. However, mulberry productivity showed a significant growth (2.40%), indicating signs of adoption of innovative technologies by farmers with increase in productivity of mulberry. During the Period IV, there was highly significant growth rate in mulberry productivity (5.01%), significant growth rate of area (3.17%) and production (1.70%). During the overall Period, even though the mulberry production (2.31%) and productivity (2.52%) were highly significant, the growth rate of mulberry area was non-significant. This might be due to acute water shortage, non-availability of labors, reduction of fertile land to real estate and also probably due to low cocoon price. Similar kind of factors has been attributed by year, 2011.

Table 1. CAGR of area, production and productivity of mulberry

Description	Period I (1971-72 to 1979-80)		Period II (1980-81 to 1989-90)		Period III (1990-91 to 1999-00)		Period IV (2000-01 to 2008-09)		Over all period (1971-72 to 2008-09)	
	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>
<b>Karnataka</b>										
Area (ha.)	2.81***	0.79	2.78***	0.98	-1.85 NS	0.28	3.17*	0.35	-0.14 NS	0.47
Production (MT)	1.91***	0.83	7.20***	0.95	0.47 NS	0.51	1.70*	0.39	2.31***	0.63
Productivity (kg/ha)	-0.87 NS	0.23	4.30***	0.91	2.40**	0.45	5.01***	0.79	2.52***	0.83
<b>Andhra Pradesh</b>										
Area (ha.)	4.00*	0.70	12.34***	0.81	9.02***	0.48	5.92***	0.72	3.34***	0.46
Production (MT)	7.70**	0.78	16.76***	0.89	7.57**	0.40	-1.50 NS	0.15	6.31***	0.72
Productivity (kg/ha)	3.55***	0.77	4.03***	0.98	1.59***	0.89	4.70***	0.90	2.87***	0.96
<b>Tamil Nadu</b>										
Area (ha.)	11.50***	0.91	8.07***	0.91	16.68***	0.81	4.60 NS	0.6	-1.41 NS	0.6
Production (MT)	16.20***	0.96	10.93***	0.96	14.10***	0.73	5.87 NS	0.10	1.67 NS	0.8
Productivity (kg/ha)	4.21***	0.97	2.64***	0.95	3.08***	0.85	1.21***	0.88	3.13***	0.97
<b>West Bengal</b>										
Area (ha.)	12.60***	0.81	5.00***	0.97	2.32***	0.81	-1.46 NS	8.24	3.28***	0.57
Production (MT)	15.85***	0.86	7.24***	0.95	6.10***	0.96	0.88 NS	3.23	6.33***	0.83
Productivity (kg/ha)	2.89***	0.90	2.13***	0.80	3.65***	0.95	2.38***	95.83	2.95***	0.99
<b>Jammu &amp; Kashmir</b>										
Area (ha.)	1.31***	0.86	14.34***	0.72	26.06***	0.69	-1.42 NS	4.05	9.24***	0.85
Production (MT)	3.87***	0.89	18.04***	0.74	34.53***	0.67	-1.21 NS	1.74	12.38***	0.86
Productivity (kg/ha)	2.52***	0.90	3.23***	0.78	6.72***	0.60	0.21 NS	0.88	2.87***	0.89
<b>India</b>										
Area (ha.)	4.70***	0.95	5.66***	0.96	3.43***	0.77	-2.50 NS	0.50	1.65***	0.28
Production (MT)	9.16***	0.97	6.11***	0.87	0.69 NS	0.7	7.48**	0.66	4.02***	0.80
Productivity (kg/ha)	4.26***	0.93	0.84 NS	0.6	4.27***	0.69	10.23***	0.85	2.32***	0.65

\*\*\*-Significant at one per cent, \*\*-Significant at five per cent, \*-Significant at 10 per cent, NS-Non-significant

During period I, CAGR of cocoon production (2.86%) was significant and accelerating but that of cocoon productivity (-2.07%) was non-significant and decelerating (Table 2). The reason was due to the poor yielding mulberry, silkworm races, with low quality and quantity of cocoon yield. The low yielding silkworm hybrids PM x C-Nichi was the dominant one, among the farmers during 1970s [6]. During the Period II, the growth of cocoon production (5.02%) and productivity (2.18%) were significant. This was in line with the findings of Masilamani, who opined that, the cocoon production in Karnataka was estimated to be 59,000 tonnes during the ten years period 1980-90, the state has made a credible progress in expansion of cocoon production up to 52 per cent under the World Bank assistance, which was highly significant. [7]

During the Period III, the CAGR in respect of cocoon production (3.09%) was non-significant, while the growth rate of cocoon productivity (5.05%) was highly significant indicating the increasing trend in cocoon productivity per unit area, might be attributed to the introduction of high yielding mulberry varieties, silkworm hybrids and scientific rearing technologies. [8] During the Period IV, non-significant growth rates of cocoon production (-1.89%) and productivity (1.35%) were observed with a reason of area under mulberry cultivation in the state was declined to 77,329 hectares during 2008-09 from 91,434 hectares during 2007-08 [9]. However, for the overall Period, the cocoon production (2.41%) and productivity (2.59%) were witnessed positive and high significant growth rates and the results trend were on par with Chandrappa that Karnataka recorded the cocoon production growth rate of 5.19 per cent during the period from 1980-80 to 1997-98. The overall trend exhibited a positive influence of vertical expansion of sericulture throughout the state including some of the non-traditional districts. [4]

### 3.2. Andhra Pradesh

During Period I, the CAGR of mulberry area (4.00%), production (7.70 %) and productivity (3.55%) have shown significant growth at 10, 5, 1 level of significance respectively. (Table 1). This may be because of introduction of K<sub>2</sub> mulberry variety and new package of practices during 1960s. There was significant and positive growth rate in respect of area (12.34%), production (16.76%) and productivity (4.03%) during Period II. This may be due to the evolution of high yielding mulberry variety, V<sub>1</sub> which was released to the field during 1990s; not only improved the leaf yield from 30 to 60 MT per ha per year, but also the leaf quality to a great extent [5]. During Period III, the growth rate of productivity (1.59%), area under mulberry (9.02%) and production (7.57%) were found significant. In the Period IV, though there was significant growth rate in area (5.92%) and productivity (4.70%), but the growth rate of mulberry leaf production (-1.50%) was found non-significant. There were highly significant growth rates in respect of mulberry expansion (3.34%); leaf production (6.31%) and leaf productivity (2.87%) were reported during the overall Period. This might be due to introduction of high yielding mulberry varieties like V<sub>1</sub> and effective water management system like drip irrigation. There was a significant growth of mulberry since 1971-72 (644 ha), 1981-82 (25,731 ha), 1991-92 (79,632 ha) and 2001-02 (52,225 ha) at Andhra Pradesh.[5]

In Andhra Pradesh though the CAGR of cocoon production (14.90%) was significant, but the CAGR of cocoon productivity (10.41%) was non-significant during the Period I (Table 2). During the Period II, the growth rate of cocoon production and productivity (16.77 and 3.94%, respectively) were found highly significant. During the Period III (-0.39%) and Period IV (-0.21%), the cocoon production has seen Non-significant negative trend, but cocoon productivity was observed a significant and positive growth with CAGR of 9.48% and 6.07% for respective periods. For the overall Period, there were significant and positive growth in respect of cocoon production (7.90%) and productivity (4.81%). This is attributed to technological adoption of interventions viz., separate chawki gardens and separate rearing houses, acceptance of innovative rearing technologies and implementation of massive bivoltine programme [10].

### 3.3. Tamil Nadu

During earlier periods of I, II and III Tamil Nadu has seen a positive and significant growth in the area, production and productivity where as in recent period IV the area and production seen a non-significant CAGR whereas a significant and positive growth in productivity was observed. The analysis of CAGR during the study Period revealed that, there was a non-significant negative growth rate of mulberry area (-1.41%) and positive production (1.67%), while productivity (3.13%) has seen a positive and significant growth, which is attributed to development of package

of practices for mulberry cultivation combined with improved rearing technology. The introduction of robust bivoltine races made possible to rear bivoltine hybrids successfully in Tamil Nadu.

As observed a significant positive growth in case of mulberry area, production and productivity during first three periods the cocoon production and productivity also seen a positive and significant growth. During the Period IV, the growth rate of cocoon production (9.64%) was non-significant, while growth rate of productivity (15.23%) was significant. During the overall study Period (1971-72 to 2008-09), though there was a significant growth rate in cocoon productivity (2.52%), the production (1.52%) was non-significant.

Table 2. Analysis of CAGR of production and productivity components of cocoon

Description	Period I (1971-72 to 1979-80)		Period II (1980-81 to 1989-90)		Period III (1990-91 to 1999-00)		Period IV (2000-01 to 2008-09)		Over all period (1971-72 to 2008-09)	
	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>	CAGR (%)	R <sup>2</sup>
<b>Karnataka</b>										
Production (MT)	2.86**	0.67	5.02**	0.88	3.09 NS	0.49	-1.89 NS	0.13	2.41***	0.66
Productivity (kg/ha)	-2.07 NS	0.21	2.18***	0.56	5.05***	0.74	1.35 NS	0.33	2.59***	0.84
<b>Andhra Pradesh</b>										
Production (MT)	14.90*	0.81	16.77***	0.89	-0.39 NS	0.44	-0.21 NS	0.22	7.90***	0.85
Productivity (kg/ha)	10.41 NS	0.67	3.94***	0.56	9.48***	0.63	6.07***	0.88	4.81***	0.87
<b>Tamil Nadu</b>										
Production (MT)	14.06***	0.91	4.52**	0.44	8.74***	0.72	9.64 NS	0.23	1.52 NS	0.10
Productivity (kg/ha)	2.29*	0.57	3.28***	0.54	8.57***	0.68	15.23*	0.49	2.52***	0.47
<b>West Bengal</b>										
Production (MT)	8.19***	0.89	7.57***	0.95	1.43**	0.42	3.77**	0.69	4.24***	0.88
Productivity (kg/ha)	-3.90 NS	0.37	2.45***	0.67	0.86**	0.31	5.31 NS	0.41	0.92***	0.20
<b>Jammu &amp; Kashmir</b>										
Production (MT)	6.04***	0.63	-2.18 NS	0.17	1.02 NS	0.10	-0.49 NS	0.23	0.11 NS	0.10
Productivity (kg/ha)	4.67 NS	0.51	14.45***	0.80	-19.85 NS	0.60	0.99 NS	0.10	8.36***	0.81
<b>India</b>										
Production (MT)	6.20***	0.83	7.14***	0.95	0.99*	0.25	-0.004 NS	0.4	4.08***	0.86
Productivity (kg/ha)	1.43*	0.21	1.75***	0.68	4.58***	0.81	2.67***	0.78	2.41***	0.81
***-Significant at one per cent, **-Significant at five per cent, *-Significant at 10 per cent, NS-Non-significant										

### 3.4. West Bengal

In West Bengal, the CAGR of mulberry area (12.60%), production (15.85%) and productivity (2.89%) were significant during the Period I (Table 1). This may be due to establishment of Central Sericulture Research and Training Institute in Berhampur during 1962, and introduction of bivoltine silkworm races such as KA, NB<sub>7</sub>, NB<sub>18</sub>, NB<sub>4</sub>D<sub>2</sub> and NN<sub>6</sub>D and bush and dwarf type of improved mulberry varieties. Similar positive and significant trend was also noticed during the Period II and III in growth rate of mulberry area, production and productivity. This was due to introduction of JICA second phase programme in 1991. In West Bengal, the extent of mulberry cultivation was 9,405 hectares during 1979-80, was increased to 12,374 hectares during 2011 [11]. But, during Period IV (2000-01 to 2008-09), there was negative and non-significant CAGR rate of mulberry area (-1.46%) and production (0.88%), which may be attributed to outbreak of pebrine disease [11], though there was a significant growth rate was evident in mulberry productivity (2.38%). However, the analysis of mulberry growth rate during the entire study Period revealed that there was a highly significant growth rate of mulberry area (3.28%), production (6.33%) and productivity (2.95%) in

West Bengal. Similar trend was observed by Ali [12], who reported the area increased from 12,976 acres in 1976-77 to 21,053 acres in 1996-97, accounting for an increase of 62.25 per cent in a period of 21 years.

In West Bengal during the Period I the CAGR of cocoon production (8.19%) was highly significant, while the productivity (-3.90%) was non-significant (Table 2). The fact was that the 60 per cent of mulberry plantation in traditional district were still with local varieties and lack of adoption of new technologies [13]. During the Period II Period III and over all Period, there was a significant growth rate for both cocoon production (7.57, 1.43 and 4.24%, respectively) and productivity (2.45, 0.86 and 0.92%, respectively). However, for the Period IV, the growth rate of cocoon production (3.77%) was significant but the productivity (5.31%) was non-significant. Similar kind of observations was made by Chandrappa. [4]

### 3.5. Jammu & Kashmir

In Jammu & Kashmir, there was a significant and positive CAGR of mulberry area, production and productivity was observed during the Period I, II and III of which there was very high growth rates were observed during III period. Trag that the status of mulberry cultivation in Jammu & Kashmir during the Period 1992-93 was 592 hectares, which increased to 7,063 hectares, which was attributed to introduction of mulberry varieties such as S-146, Chinese White, Himachal Local, Tr-10 and Chak Majra for plantation under sub-tropical regions; whereas, Chinese White, Goshorami, Ichinose, KNG, Kokuso etc we advocated for temperature agro-climatic region [14], However, area (-1.42%) and production (-1.21%) has seen a negative trend in IV period. This might may be due to the lack of technology in mulberry cultivation and infrastructural support for rearing of bivoltine silkworm and raising of local variety of mulberry as trees, which are poor yielder and poor in nutrition and poor in implementation of new technologies by introduced by different institutes in different sector of silk industry [8]. Overall the area (9.24%), production (12.38%) and productivity (2.87%) have seen a positive and significant trend.

In Jammu & Kashmir the CAGR of cocoon production (6.04%) was highly significant, while growth rate of productivity (4.67%) was non-significant during the Period I (Table 2). Period II registered non-significant growth rate of cocoon production (-2.18%), while the growth rate in respect of productivity (14.45%) was highly significant apparently due to the management of silkworm diseases and pests more efficiently by using effective rearing practices, disinfectants and chemicals, better extension management system to improve production and productivity and adoption of appropriate technologies supported by Central Sericulture Research and Training Institute, Pampore (J&K) [14].

During the Period III and Period IV, the growth rates of cocoon production (1.02 and -0.49%) and productivity (-19.85 and 0.99%) were found non-significant. Similar trend was observed by Nagaraju (2008) [15] who reported the cocoon production during 1980-81 as 1,036 MT and was subsequently reduced to 738 MT (2008-09). The other reason might be attributed to the sociological reasons which the values are facing in those periods. Overall, the growth of cocoon production (0.11%) was non-significant, but the growth rate of cocoon productivity (8.36%) was significant. Ahsan reported similar results, the reason attributed was due to the cultivation of improved mulberry varieties because the Jammu & Kashmir sericulture is based on tree type of plantations and technological interventions from institutions for rearing of bivoltine races in that entire periods [8].

### 3.6. India

In India, Mulberry area (4.70%), production (9.16%) and productivity (4.26 %) have seen a significant and positive growth during I period indicated by CAGR. (Table 1; Fig 1). This may be due to introduction of high yielding mulberry varieties such as V<sub>1</sub> and S -series by Central Silk Board institutions [16]. However, during the Period II, there was highly significant growth rate in respect of mulberry area (5.66%) and production (6.11%) with a non-significant growth rate of mulberry productivity (0.84%).

During the Period III, the CAGR of mulberry area (3.43%) and productivity (4.27%) were highly significant; but the growth rate of leaf production (0.69%) was non-significant, this may be due to occurrence of pebrine disease, which troubled the silk industry during 1991. During the Period IV, even though there was a significant improvement in mulberry production (7.48%) and productivity (10.23%), which attributed due to introduction of high yielding mulberry varieties, there was a non-significant negative growth rate of mulberry area (-2.50%). Some of the reasons attributed for this are reduction in fertile land, labor shortage and varied cocoon price. Overall in India the area (1.65%), production (4.02%) and Productivity (2.32%) have seen a significant and positive growth during study period.

In India during period IV the production (-0.004%) of cocoon has seen a negative and non-significant growth and production (2.67%) has seen a positive and significant growth. Whereas during first 3 periods production, productivity has recorded a significant and positive growth (Table 2; Fig 2). Similar trends were reported by Chandrappa, the swift increase in the state-wise CAGR of cocoon production for a period of 18 years (1980-81 to 1997-98) with the highest annual growth rate was observed in Karnataka (5.19%) and West Bengal (5.18%) [4] and Babulal have also reported the similar trend [17]. In China the cocoon production increased at the rate of 52.50 per cent in 2007. During the overall Period there was a positive and significant growth rate of cocoon production (4.08%) and productivity (2.41%) [18].

Figure 1. Cocoon production in India and five traditional sericulture states

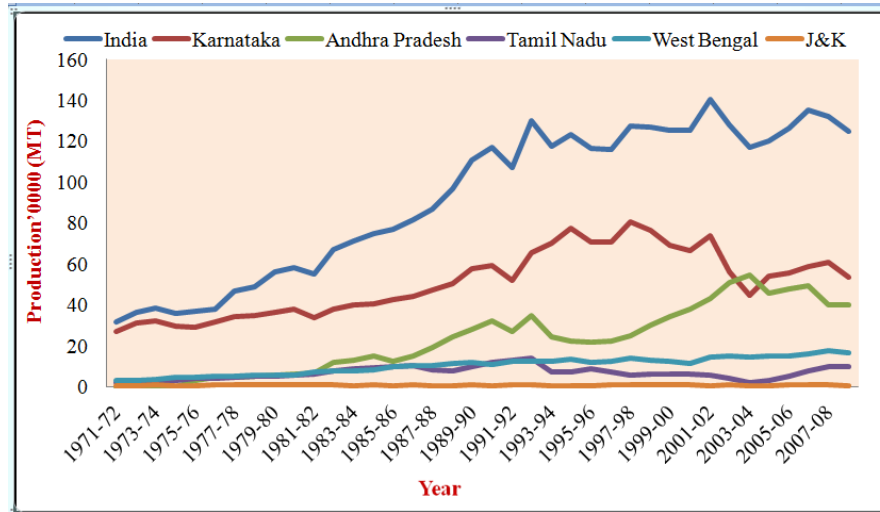
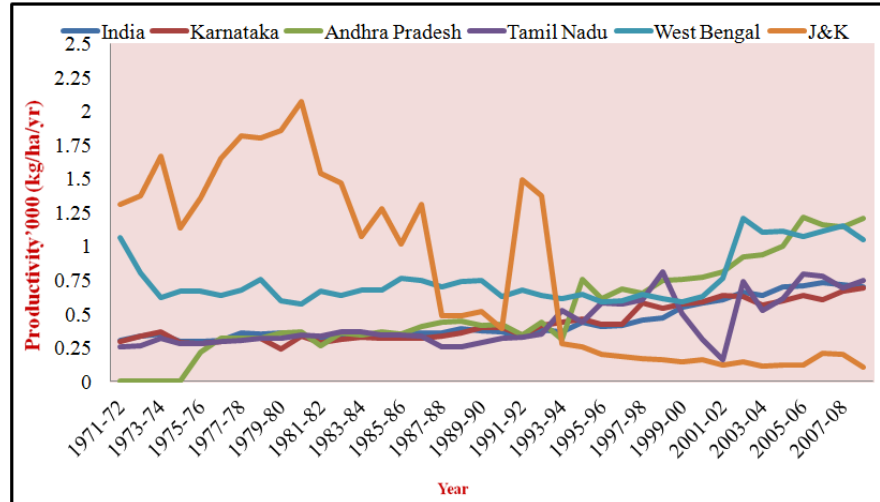


Figure 2. Cocoon productivity in India and five traditional sericulture states



#### 4. Conclusion

The analysis of the growth in area under mulberry cultivation reveals the declining year after year due to fertile land sold to non-agricultural activities, non-availability of labors and also low cocoon price in major traditional mulberry growing States such as Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu & Kashmir. Even though the area under mulberry cultivation reduced, the production and productivity of mulberry area increased due

to the technological interventions or developments by different institutions and adoption of those improved technologies by the farmers in sericulture. The similar declining trend is seen even in cocoon production. Hence the present study highlights the need of sericulture friendly policy interventions in the traditional states especially Karnataka by assuring minimum price for Cocoon thereby reducing the volatility in the prices.

## 5. Acknowledgement

We are thankful to Dr. K B Umesh, Dr. Bhanuprakash, Dr. D Manjunath Gowda for their continuous and fruitful suggestions for thesis.

## 6. References

1. Kshama giridhar, J.C.Mahanta, B.M.Kantharaju, S.Nagesh. Silk export and import review. *Indian Silk*, 2011; 2(1), 44-45.
2. Anonymous. Silk export and import review. *Indian Silk*. 2011; 2(4), 40-43.
3. T.N.Hajare, A.D.Jadhav, Jagadish prasad, O.Challa and L.B.kalantri. Sericulture brings better income. *Indian Silk*, 2008; 46(9), 27.
4. D.Chandrappa, K.B.Umesh, Ramakrishna naika and R.Govindan. Dynamics of mulberry Sericulture growth in India. *Bulletin Indian Academy Sericulture*. 2006; 10(1), 33-41.
5. S.M.H.Qadri and P.Kumaresan. Fifty years of research at Central Sericultural Research and Training Institute, Mysore. *Golden Jubilee National Conference on Sericulture Innovations: Before and Beyond, CSR&TI, Mysore*.2011; 11-26.
6. S.Lakshmanan, R.G.Geetha devi. Studies on economics of sericulture under dry farming condition in Chamarajanagar district of Karnataka. *Indian Journal of Sericulture*. 2005; 44(2), 183-185.
7. S.Masilamani, C.M.Kishor kumar, V.Thiagarajan. Time series analysis for mulberry silk cocoon price in major cocoon markets of Karnataka. *Agricultural Situation in India*, 1996; 53(4), 219-224.
8. M.M.M. Ahsan. Sericulture status and technologies for cold and temperature conditions in India. *National Conference on Strategies for Sericulture Research and Development, CSR&TI, Mysore*, 2000, 41-46.
9. Anonymous. Silk production sees a sharp fall. Upkar Prakashan Publications, [www. Pratiyogitadarpan.org](http://www.Pratiyogitadarpan.org).2009; 118-119.
10. Venkateswarlu. Status of sericulture in Andhra Pradesh, *Souvenir, National Seminar on Mulberry Sericulture Research in India, KSSR&DI, Bangalore*. 2001; 18-20.
11. S.K.Thade. Status of sericulture in West Bengal. *Souvenir, National Seminar on Mulberry Sericulture Research in India. KSSR&DI, Bangalore*.2011; 8-10.
12. E.Ali, Snehasish saha and Sultana parveen. Present scenario of mulberry cultivation in Malda. *Indian Silk*, 2008; 47(6), 4-7.
13. S.K.Sen. Strategies for development in the new millennium. *Indian Silk*, 2000; 38(9&10), 104-106.
14. A.R.Trage, A.K.Misri and D.U.Basharath. Strategies for the development of sericulture in J&K state in the new millennium. *National Seminar on Mulberry Sericulture Research in India. KSSR&DI, Bangalore*. 2001; 11-17.
15. L.Nagaraju. Silks of India grace and lustre. [www.biotechnews.in](http://www.biotechnews.in). 2008; 3(5), 4-7.
16. S.Lakshmanan. Growth trends in mulberry silk production in India- an economic analysis. *Financing Agriculture* 2007; 39(4), 28-30.
17. Babulal, R.K.Khatri, A.K.Sharma and V.P.Sharma. Impact of extension on mulberry cocoon productivity in Uttarakhand. *Indian Silk*. 2010; 1(2), 16-17.
18. L.Feng, S.Shimin and Q.Xianjuan. China-Indian silk trade: Current production and future prospects. *Chinese Journal of Population, Resource and Environment*. 2009; 7(2), 91-96.

*The Publication fee is defrayed by Indian Society for Education and Environment ([www.iseeadyar.org](http://www.iseeadyar.org))*

### **Cite this article as:**

M. Manjunath, K.C. Narayanaswamy, Savithramma, S. Harish babu, H. V. Harishkumar. Scenario of mulberry and cocoon production in major silk producing States of India- Application of exponential growth function. *Indian Journal of Economics and Development*. Vol 3 (8), August 2015.