



Title: Total Factor Productivity of Cotton in India

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Introduction

Agricultural output is determined by the inputs used in production and the efficiency or productivity with which those inputs are used. The changes in Total Factor Productivity (TFP) is a key concept for the acceleration of output growth and reflects the extent of sustainability of the system. This indicates role of technology in increasing resource use efficiency and thus widening carrying capacity of the system. Cotton, one of the principal crops of the country, plays a key role in the Indian economy and is of a vital importance to the nation being provider of employment to millions of farmers. This project is an attempt in this direction

Objectives

- To examine the trends in area, production and productivity of cotton in major cotton growing States of India and issues related to overall performance of the cotton crop;
- To construct the district-wise total factor productivity indices under different agro climatic zones of cotton growing States in India;
- To examine the changes in TFP of cotton and to identify the factors influencing such changes
- To suggest policies and strategies to sustain the growth in TFP by district and region wise with reference to cotton economy.

Activities

Growth analysis was done by estimating compound growth rates of cotton area, production and productivity in different time periods in important cotton growing districts of the country. The period considered for the analysis was 1980-81 to 2006-07.

The growth model adopted is as follows:

$$V_t = AB^t$$

Where,

V_t = Area/production/yield of a crop for the year 't'.

t = Time variable (1,2, ... n) for each period.

A = Constant

B = Coefficient

Tornqvist-Theil TFP indices were used to compute Total Factor Productivity of cotton. The Tornqvist-Theil index is a superlative index, which is exact for the linear homogeneous translog production function. A further advantage of the Tornqvist-Theil index is that it accounts for changes in quality of inputs. Expressed in logarithmic form, the Tornqvist-Theil index is given by the following equation

$$\ln (TFP_t / TFP_{t-1}) = \ln (O_t / O_{t-1}) - \% D (C_{1t} + C_{2t}) \ln (X_t / X_{t-1})$$

Where

O_t = out put of cotton in year 't'

C_n = Share of input 'i' in total input cost

X_{it} = Input 'i' in year 't'

Specifying the index equal to 100 in a particular year and accumulating the measure based on above equation provides the TFP index.

EXECUTIVE SUMMARY

Growth analysis indicated that in Punjab, Haryana, Gujarat, Maharashtra, Madhya Pradesh and Andhra Pradesh cotton area, production and productivity recorded a positive growth. In Karnataka and Tamil Nadu growth of cotton area was negative. Cotton production also showed negative growth in Tamil Nadu.

In Punjab and Haryana, the TFP of cotton was declining since mid 90's due to over mechanization, stagnant yield and high input costs. In Rajasthan TFP index of cotton was maximum (1.74) during the period 1997-98 followed by 2000-01 and 2002-03.

In Gujarat TFP index ranged from 0.7376 to 1.6824 during the period 1982-2004 and was highest in the year 2003-04 followed by 1987-88. In Maharashtra It was highest in the year



2003-04 and ranged from 0.7748 to 1.3337 during the period 1995-2004. In Madhya Pradesh TFP index ranged from 0.8264 to 1.6857 during the period 1996-2004 and was highest in the year 2000-01.

Total Factor Productivity analysis revealed that in Andhra Pradesh and Karnataka total input index has been increasing constantly during the period 1994-95 to 2003-04 due to increase in cost of all inputs. TFP index ranged from 0.58 to 1.89 in Andhra Pradesh and 1.24 to 2.30 in Karnataka. The TFP index of Tamil Nadu State showed a declining trend till 2003-04 and always remained less than one.

Salient findings:

Growth analysis:

The compound growth rates (CGR) of area, production and yield of cotton were estimated for the period 1980-81 to 2007-08. In Punjab the area under this crop decreased significantly from 648 thousand hectares to 557 thousand hectares at a compound growth rate of 1.01 per cent per annum, which implies stagnancy in area due to wide fluctuations in the study period. However, the production and productivity of cotton showed an increasing trend but statistically non-significant. Increasing trends were found in area, production and productivity of cotton in Haryana. The results of CGRs indicate that area and production of cotton during this period increased significantly at a growth rate of 2.62 per cent and 3.24 per cent per annum respectively. However, the result of productivity was non-significant for this period. In Rajasthan, overall analysis reveals that the area under cotton significantly increased from 356.9 thousand hectares to 470 thousand hectares at growth rate of 1.51 percent per annum.

In Gujarat Cotton area increased from 15.72 lakh ha in 1980-81 to 25.16 lakh ha in 2007-08 where as cotton production increased from 17.14 lakh bales to 110 lakh bales. Cotton productivity in Gujarat increased from 185 kg per ha to 743 kg per ha during the same period. Cotton area increased at a rate of 1.88 percent per annum during 1980-08 where as cotton production and productivity increased at a rate of 7.37 and 5.41 percent respectively. In Maharashtra cotton area increased at a rate of 1.44 per cent per annum only where as production increased at a rate of 6.61 percent and productivity increased at a rate of 5.10 percent during 1980-2008. In Madhya Pradesh cotton area increased at an average rate of 0.09 percent per annum only where as production and productivity increased at a rate of 8.97 and 7.47 percent per annum respectively during the period under study.

During 1980-81 to 2007-08 the area, production and yield have grown positively and significant at one percent level in Andhra Pradesh. It was found that, during the past 28 years, the area, production and yield of cotton has increased and thus had a positive growth rate in Andhra Pradesh even though minor

changes in the different periods were observed. In Karnataka, the area has declined significantly at the rate of 3.12 per cent per annum, while production has declined but non-significant level and yield has significantly increased at the rate of 4.84 per cent per annum. During the period of analysis (1980-81 to 2007-08) in Tamil Nadu only the yield has increased positively, and the area and production had shown only a negative growth rate.

Analysis of total factor productivity:

The data for entire period of analysis are currently not available for all the States excepting Punjab. Hence the study restricts the analysis to the available years. (Table 1)

Table 1 : TFP of Cotton in different states of India

Period	Punjab	Haryana	Rajasthan	Gujarat	Maharashtra	MP	A.P.	Karnataka	TN
1980-81	1								
1981-82	0.76								
1982-83	0.61			1.00					
1983-84	1.11			1.08					
1984-85	1.03			0.81					
1985-86	0.89			1.10					
1986-87	1.39			0.69					
1987-88	0.85	1		1.46					
1988-89	1.03	1.82		0.90					
1989-90	0.78	0.63		0.94					
1990-91	1.17	0.57		0.98					
1991-92	0.88	0.93		1.04					
1992-93	0.88	0.49		0.90					
1993-94	1.09	0.36		1.14					
1994-95	0.79	0.54	1	1.06			1.89	1.66	0.93
1995-96	0.67	0.17	0.73	1.03	1.00		1.27	1.14	0.75
1996-97	0.48	0.20	0.74	0.78	1.19	1.00	1.42	1.19	0.75
1997-98	0.47	0.55	1.74	1.12	1.34	1.01	1.28	0.52	0.78
1998-99	0.55	0.28	0.83	0.91	1.25	0.91	1.47	0.45	0.67
1999-00	0.731	0.19	0.92	0.68	1.40	0.89	1.77	1.14	0.64
2000-01	0.51	0.23	1.55	0.73	0.95	1.69	1.31	0.42	0.61
2001-02	0.62	0.67	0.67	1.16	1.34	0.83	1.37	0.84	0.65
2002-03	0.86	0.22	1.13	0.96	1.40	0.87	1.04	0.89	0.70
2003-04				1.55	1.63	1.36	0.85	0.48	0.52

The TFP index of Punjab state was the highest during 1986-87 (1.39) and the lowest during 1997-98 (0.47). The cotton crop was damaged during the period 1996-97 to 2001-02 due to the severe attack of pest and diseases. The TFP index was found to be more than one during the years 1983-84, 1984-85, 1988-89, 1990-91 and 1993-94 and rest of the years, it was less than one, which indicate the lower returns of cotton cultivation. The TFP index was less than 1 for all the periods in Haryana except 1988-89 where it was accounted to 1.82. During the year 1997-98, the TFP index of cotton for Rajasthan state was the maximum (1.74), followed by 2000-01 and 2002-03. For rest of the period it was less than one. In Punjab and Haryana states, the TFP of cotton was declining since mid 90's due to over mechanization, stagnant yield and high input costs.

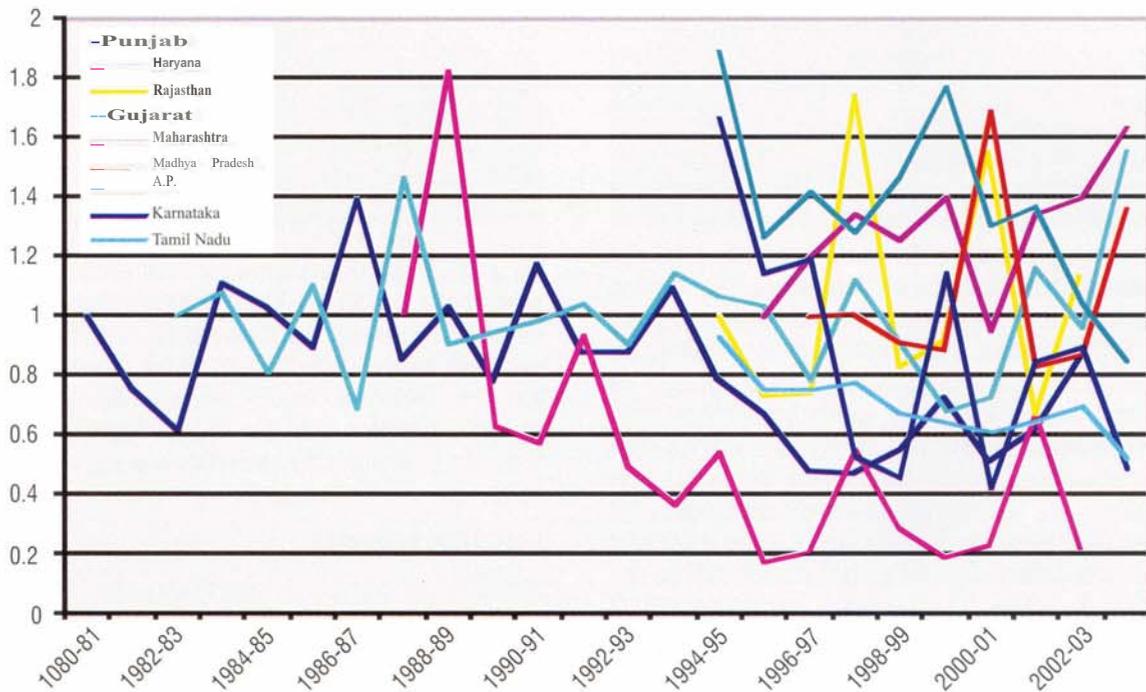
Total Factor Productivity index of cotton in Gujarat ranged from 0.7376 to 1.6824 during the period 1982-2004. It was highest in the year 2003-04 followed by 1987-88. Total Factor Productivity was lowest in the year 1999-2000 followed by



1986-87. Total Factor Productivity index of cotton in Maharashtra ranged from 0.7748 to 1.3337 during the period 1995-2004. It was highest in the year 2003-04, followed by 1999-2000. Total Factor Productivity was lowest in the year 2000-01 followed by 1995-96. Total Factor Productivity index of cotton in Madhya Pradesh ranged from 0.8264 to 1.6857 during the period 1996-2004. It was highest in the year 2000-01 followed by 2003-04. Total Factor Productivity was lowest in the year 2001-02 followed by 2002-03.

The result of Total Factor Productivity analysis of cotton in Andhra Pradesh revealed that the total input index of cotton in the case of Andhra Pradesh has been increasing constantly from 1.14 to 2.55 during the period 1994-95 to 2003-04. This is due to the increase in cost of all the inputs over the past ten

years. Particularly the cost of insecticides and pesticides are found to be increasing rapidly in the recent years. TFP index ranged from 1.89 to 0.58 during the period of analysis. In Karnataka the total input index of cotton has been increasing constantly from 1.24 to 2.30 during the period 1994-95 to 2003-04. This indicates the gradual increase in the cost of inputs in cultivation of cotton during this period. Thus, the TFP index of cotton for Karnataka during the year 1994-95 was maximum (1.66), followed by 1995-96 (1.14), 1996-97 (1.19) and 1999-2000 (1.14). For rest of the periods the indices were lesser than one, which indicates that return to the cost of cotton was very low. The TFP index of Tamil Nadu State has shown only a declining trend till 2003-04 and always less than one. It is essential to incorporate the recent data to confirm the declining TFP in Tamil Nadu.



Total factor productivity of cotton in India

