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Growth Patterns of Total Pulses Production in India

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Abstract

Pulses are an important food crops in the country. The crop supplied a major part of food security in the country. We have estimated the state wise production growth rates of total pulses in India during 1980-81to 2015-16. We have selected 15 agriculturally developed states for our research study. The secondary data on total pulses production are collected from the Reserve Bank of India, Different issues of Statistical Abstract of India (BAES). We have applied stochastic trend i.e., either TSP or DSP of non-stationary series for checking the production growth rates of total pulses in the country. In the case of stationary series, we have applied deterministic trend i.e., kinked exponential trend equation for estimating the production growth rates of total pulses in the country during the study period from 1980-81 to 2015-16. The production growth rates in total pulses are significantly positive with low value in a few states but most of the states in the country experienced either negative or no growth in this production over the whole study period. But in the case of sub-period growth rates, we observed that the production growth rates of total pulses in most of states had been either significantly negative or insignificant in the third or fourth sub-period as compared to the other sub-periods in the country.

***Key words*:** Trend stationary process, Difference stationary process, Kinked growth, Pulses production

The agricultural sector played a crucial role in the Indian economy in the pre-independence era starting from ancient civilization. Its importance for the betterment of the Indian economy was recognized from this historical period [1]. After 1966-67 the impact of the green revolution policy adopted by Govt. in the country was being realized. The then administration of the country thought that the import dependency on foodgrains could not be sustained for a long time [2]. They took the Intensive Agricultural District Programme (IADP) for the development of foodgrains production and other commercial crops in 1962. The government of India selected seven districts from all over the country for IADP and tested the agricultural performance by using modern technology and high yielding verity seeds [3]. After the achievement of desired result from IADP, the government took another policy, viz Intensive Agricultural Area Programme (IAAP) in 1964. The government has selected one district from each and every state of the country for the pilot study of IAAP on agricultural performance in the second time [4-5]. The administration of the country observed that the production of foodgrains increased significantly in all the districts by the introduction of the two policies, namely IAAP and IADP in the country. Then the government finally announced ad to initiative for the implementation of the green revolution in all over India since mid-1960s [6]. This revolution of agriculture might also be termed as the seed-water-fertilizer revolution. The agricultural production of foodgrains increased by using modern technology, like high yielding varieties of seed, fertilizer, pesticides, agricultural machinery and modern irrigation facility in the country. Many types of high yielding seeds, namely Lerma Rojo, Sonara-64, Kalyan and P.V.18 came from Mexico for improvement of foodgrains production in the country during this time period. The agricultural production of foodgrains increased rapidly in the country. The production of wheat increased 8.25 million tonnes from 1965-66 to 1968-1969 in the country [7]. The production of rice also played a significant role during this time period. But the commercial crops and pulses production did not have any remarkable role. The production growth rate of wheat was 5.03 percent and that of rice was 1.84 percent during the early green revolution period. The production growth rate of total foodgrains was found to be 2.19 percent during this period [8]. Further, the performance of the agricultural sector improved remarkably for a few states namely, Punjab, Haryana and Western part of Uttar Pradesh but most of the other states as well as the eastern part of the country did not show any better performance in foodgrains production in the green revolution period [9].

Pulses are a substantial source of vitamins, minerals, and proteins in the human body. They also play a major role in the nation's food and nutritional security [10]. India played a significant role in pulses production in the world. The area of pulses cultivation is significantly high in Madhya Pradesh. The state contributes 21 percent of the total area for pulses cultivation in India followed by Rajasthan (16 percent), Maharashtra (15 percent), Uttar Pradesh (10 percent), Karnataka (8 percent), Andhra Pradesh (4 percent), Gujarat (4 percent) and Jharkhand (3 percent). Pulse productivity which was 441 kg/ha in 1950 increased up to 820 kg/ha during 2020-21 in the country (Annual Report- 2021-22 DPD, Bhopal). But

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the recent times the cultivation of pulses continuously decreased in the country because the production cost of pluses cultivation is comparatively high. Further, the price of agricultural inputs increased at a very high rate but the price of output is more or less constant. It has resulted that the pulse cultivators of the country are facing a huge amount of loss in the country [11]. Further, the productivity of pulses is very low compared to the food crops as well as commercial crops in the country. This resulted in the pulses cultivators of the country changing their cropping pattern from traditional pulses production to high-valued commercial crops or horticultural crops during this time period. The main objective of our study is whether the growth patterns of total pulses production of different states in India varies over time or not. Further we want to check whether the production series of total pulses for different states in the country either stationary or not during the study period.

MATERIALS AND METHODS

We have collected secondary time series data on pulses production for 15 selected states in India during 1980-81 to 2015-16 from different issues of Statistical Abstract, EPWRF, different publications of Agricultural Statistical Glance, Ministry of Agriculture and the different publications of Reserve Bank of India for estimation of the agricultural growth pattern of rice crop in India.

Most of the researchers have used deterministic trend for estimation of agricultural growth rates. But the random shock in the deterministic trend method is assumed to be temporary. In the case of long time series data, the variance does not remain constant over time due to the unit root problem. If the unit root problem is present in a series then the series is said to be non-stationary. In the case of non-stationary series, the deterministic trend method does not give robust and error free results for the estimation of growth rates in agricultural crop output. To overcome this problem, we have been checked the stationarity of the time series data by using the Phillps-Perron test [12].

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \gamma t + \epsilon_t \text{ .... (I)}$$

If the series is found to be statistically significant at either 1 percent or 5 percent level then the series is stationary, otherwise, it is non-stationary.

We have selected the Bai-Perron model with multiple structural breaks [13-14] test for checking structural breaks in our data set. A maximum number of three structural breaks have been selected in our study period (1980-81 to 2015-16).

We have selected trend stationary process or difference stationary process method for estimation of the agricultural growth rate of non-stationary series.

$$\Delta Y_t = \alpha + \beta t + \theta_1 DU1_t + \gamma_1 DT1_t + \theta_2 DU2_t + \gamma_2 DT2_t + \theta_3 DU3_t + \gamma_3 DT3_t + \rho Y_{t-1} + \sum_i^k Q_i \Delta Y_{t-i} + \epsilon_t \text{ .... (II)}$$

We have been estimated the growth rates of non-stationary series on area, production and productivity for total pulses by using this equation. Here $DU1_t$, $DU2_t$ and $DU3_t$ are the sub-period wise dummy variables, that represent the nature of the level of growth (i.e., either positive or negative) in the respective sub-periods. Here $DT1_t$, $DT2_t$ and $DT3_t$ are also the sub-period wise dummy variables representing respective slopes or trend growth rates of the underlying series. Thus,

$$DUi_t = \begin{cases} 0 \text{ .... when } t \leq TBi \\ 1 \text{ .... when } t > TBi \end{cases} \qquad DTi_t = \begin{cases} 0 \text{ .... when } t \leq TBi \\ t - TBi \text{ when } t > TBi \\ (\text{sequentially like}, 1,2,3, \ldots\ldots\ldots) \end{cases}$$

where i = 1,2,3.

But in the case of stationary series, we have estimated the growth rates of agricultural area, production and productivity by using the widely applicable deterministic trend method in which, however, we have chosen the kinked exponential trend method for estimating sub-period growth rates [15] and exponential trend method for estimating whole period growth rates.

RESULTS AND DISCUSSION

We have taken the study period from 1980-81 to 2015-16 for which the pulses growth rates for different states in India are estimated by using the exponential trend equation. The Phillips Perron test statistics represent that 4-underlying series on production having unit root problem (thus non-stationary) and the rest of the series (i.e., 12 numbers of series) are found to be stationary (Table 1).

Table 1 Estimated results of Phillips Perron unit root test for total pulses in India during 1980-81 to 2015-16

Region	State	Production
North Indian States	Uttar Pradesh	-2.594 (0.284)
	Punjab	-5.832*** (0.000)
	Haryana	-5.301*** (0.000)
South Indian States	Andhra Pradesh	-4.399*** (0.006)
	Kerala	-5.836*** (0.000)
	Karnataka	-3.953** (0.020)
	Tamil Nadu	-2.453 (0.347)
East Indian States	Assam	-4.947*** (0.001)
	Bihar	-2.043 (0.557)
	Orissa	-3.305 (0.082)
	West Bengal	-6.340*** (0.000)
West Indian States	Rajasthan	-5.432*** (0.000)
	Gujarat	-3.684** (0.036)
	Maharashtra	-6.539*** (0.000)
	Madhya Pradesh	-4.128** (0.013)
India		-4.244*** (0.010)

***Significant at 1% level
**Significant at 5% level, *Significant at 10% level

The whole period and sub-period growth rates of stationary series are reported here in percentage per annum form.

For the analysis the growth rates are divided into following five types:

1. Significantly high growth whose value is more than 5 percent (Gr > 5%)
2. Significantly medium growth whose value lies between 3 to 5 percent (3 < Gr ≤ 5%)
3. Significantly low growth whose value lies below 3 percent (0 < Gr ≤ 3%)
4. Insignificant growth whose value is equal to zero. (Gr = 0)
5. Significantly negative growth whose value is less than 0 percent (Gr < 0)

Data depicted in (Table 2), presents the estimated production growth rates of total pulses. Production growth in total pulses is at significantly medium category in Andhra Pradesh (3.5%) and Karnataka (3.2%). There are four other states, namely, Assam, Gujarat, Madhya Pradesh, Maharashtra and also India where production growth rates in total pulses are significantly low. Kerala registered significantly negative growth highest magnitude in total pulses production with the value -7.7% followed by Punjab with -5.8% and Haryana with -5.5% over the study period. All other states in the country registered insignificant growth in total pulses production.

Table 2 State wise estimated sub-period growth rates of total pulses production in India, 1980-81 to 2015-16

State	TB_1	TB_2	TB_3	Whole period	1st Sub period	2nd sub-period	3rd sub-period	4th sub-period	D.W+	R^2
Punjab	1997-98	2005-06	2011-12	-5.8*** (-9.395)	-5.6 (-4.339)	-12.9*** (-4.856)	-5.5 (-1.263)	-28.0*** (-3.957)	1.860	0.867
Haryana	1991-92	1999-00	2011-12	-5.5*** (-6.775)	2.1 (0.573)	-13.1*** (-3.205)	-2.4 (-0.829)	-16.6 (-1.643)	1.730	0.652
Andhra Pradesh	1986-87	1993-94	2011-12	3.5*** (14.764)	6.4** (2.621)	0.6 (0.452)	4.9*** (9.703)	-3.6 (-1.323)	1.787	0.900
Kerala	1996-97	2002-03	2010-11	-7.7*** (-7.039)	4.8* (1.894)	-22.8*** (-3.654)	-5.8 (-1.067)	-26.7*** (-2.878)	2.343	0.768
Karnataka	1988-89	2001-02	-	3.2*** (11.194)	-0.8 (-0.449)	2.5*** (3.232)	5.0*** (6.642)	-	2.021	0.911
Assam	1990-91	1999-00	2008-09	1.3*** (3.221)	3.0*** (2.782)	-4.1 (-1.557)	1.5 (0.744)	12.8** (2.558)	1.991	0.451
West Bengal	1996-97	2004-05	2011-12	-0.8 (-1.458)	-3.5*** (-4.512)	2.7* (1.852)	-4.7** (-2.369)	16.5*** (4.281)	1.987	0.570
Rajasthan	1986-87	1999-00	2010-11	1.1 (1.608)	-4.6 (-0.638)	1.2 (0.524)	0.7 (0.233)	8.9 (1.195)	2.146	0.133
Gujarat	1985-86	1999-00	2011-12	1.5*** (2.768)	-6.9 (0.743)	1.9 (1.166)	2.5 (1.326)	-3.9 (0.550)	1.891	0.232
Maharashtra	1990-91	2000-01	2011-12	2.5*** (6.044)	6.1*** (3.173)	1.9 (1.267)	2.9* (1.914)	-9.3* (-1.931)	2.045	0.655
Madhya Pradesh	1987-88	2000-01	-	2.2*** (8.516)	2.7 (1.289)	1.3 (1.646)	3.1*** (4.429)	-	1.850	0.836
India	1998-99	2003-04	2010-11	1.1*** (6.799)	0.8* (1.939)	1.8 (1.352)	-0.4 (-0.983)	3.6* (1.709)	1.947	0.589

***Significant at 1% level, **Significant at 5% level, *Significant at 10% level

+ Disturbance term is free from autocorrelation problem. TB_i denotes i_{th} break in the series concerned

From (Table 2), we observe that the production growth rate of total pulses increased in Assam (from 3% to 12.8 %) and the whole India (from 0.8% to 3.6%) during the fourth sub-period compared to the first sub-period. We also see that the production growth rate in total pulses decreased from 6.4% to 4.9% in Andhra Pradesh and 6.1% to 2.9% in Maharashtra in the third sub-period compared to the first sub-period. Kerala achieved significantly medium growth (4.9%) in the first sub-period, while it is found to be medium in Madhya Pradesh in the third sub-period. The production growth rate of total pulses production in Karnataka significantly increased in the third sub-period, while West Bengal achieved significantly high growth in the fourth sub-period compared to the second sub-period. These observations indicate fluctuations in the production growth rates of total pulses across different regions and sub-periods [16].

Table 3 State wise estimated growth rates of total pulses production for different break points in India, 1980-81 to 2015-16

State	TB_1	TB_2	TB_3	Constant	Bt	θ_1	γ_1	θ_2	γ_2	θ_3	γ_3
Uttar Pradesh	1989-90	1997-98	2006-07	0.017 (0.039)	0.001 (0.025)	-0.084 (-0.503)	0.007 (0.103)	-0.077 (-0.568)	0.000 (0.006)	-0.054 (-0.417)	-0.015 (-0.617)
Tamil Nadu	1993-94	2003-04	-	1.491*** (2.990)	-0.132** (-2.801)	0.040 (0.171)	0.159** (2.584)	-1.033*** (-3.096)	0.128*** (3.395)	-	-
Bihar	1988-89	1995-96	2003-04	0.068 (0.097)	0.00 (0.001)	-0.058 (-0.343)	-0.009 (-0.086)	-0.128 (-0.884)	0.045 (1.262)	-0.207 (-1.608)	-0.013 (-0.581)
Orissa	1985-86	1991-92	1996-97	-0.019 (-0.058)	0.007 (0.753)	-0.155 (-0.565)	0.013 (0.164)	-0.9355* (-2.074)	0.204 (1.321)	-0.632* (-1.741)	-0.182 (-1.331)

***Significant at 1% level, **Significant at 5% level, *Significant at 10% level

T- Values are within parentheses, TB_i denotes i_{th} break in the series concerned

Now, we analyze the production growth rates of non-stationary series corresponding to the different observed break points. From (Table 3) we observe that the growth rates of total pulses production increased but its level decreased in Tamil Nadu from 1993-94 to 2003-04. On the other in Orissa there was no growth in total pulses production with significantly declining its level from 1991-92 to 1996-97. The rest of the other states are found to have insignificance in both the slope and the level in the country [17-18].

CONCLUSION

The significance level of the coefficients in this regression analysis shows that the production growth rates of pulses are positive yet low in a few states. Few other states have either negative or insignificant growth in pulses production over the study period. We have also calculated the sub-period growth rates of pulses production in the country. From the estimated results it was observed that the growth rates of pulses significantly declined in the fourth sub-period compared to the other previous sub-periods for most of the states in the country. In recent times the farmers of the country have been producing more high-valued cash crops which resulted in the production growth rates of those crops. As a result, the area growth rates of pulses significantly declined over the study period. This change in cropping pattern from traditional pulses cultivation to other high valued cash crops or horticultural crops in the country is the primary reason for decline in the production of pulses. The price and productivity of the pulses are generally low compared to the other crops but the cost of production has been continuously increasing since the liberalization period. This has resulted in decline in profitability of producers in the recent time. The pulses producers have taken a huge amount of loans to meet their additional high cost of agricultural activities from the moneylenders. The interest rate of this informal debt is very high which resulted in the entrapment of the farmer in debt-trap and consequently suicides of agricultural farmers have become a common phenomenon. This scenario concludes that the farmers of the country are price-responsive and rational.

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