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Trends in area, production and productivity of major pulses in Karnataka and India: An economic analysis

Avinash CS and BL Patil

Abstract

A majority of Indian population (40%) is vegetarian and pulses are playing an important role in providing protein (22%) and other essential nutrients to the large population of the country. However, its area is fluctuating from year to year due to number of biotic and abiotic stresses, which are responsible for a large extent of the instability and low yields. To study the growth status of major pulses in Karnataka and India growth rate in area, production, productivity, selected pulse crops were computed for a period of 36 years from 1980 to 2016 depending upon the availability of data. In pertain to total pulses scenario in Karnataka revealed that the growth in area, production and productivity were positive in all the period except productivity (-0.82%) in period-I. It is important to highlight that though the growth rates of productivity is found negative but the production found positive in period-I. The country as a whole showed positive growth in area, production and productivity in all the period but it is worth noting that the production and productivity found positive and significant in all the period.

Keywords: compound growth rate, growth direction, major pulses and total pulses

Introduction

Pulses have been cultivated since time immemorial in rainfed conditions characterized by poor soil fertility and moisture stress environments. These are leguminous plants and belong to the Fabaceae family. Pulses are also an excellent feed and fodder for livestock. Endowed with the unique ability of biological nitrogen fixation, carbon sequestration, soil amelioration, low water requirement (250 to 300 mm) and capacity to withstand harsh climate, pulses have remained an integral component of sustainable crop production system, especially in the dry areas (Anon.,2016a) [2]. Pulses are the primary sources of protein (22%) for the poor and the vegetarians (40%). The total pulse constitutes redgram, bengalgram, greengram, blackgram, lentil, horsegram, cowpea and fieldpea. The split grains of these pulses are called *dal* and are excellent source of high quality protein, essential amino acids and fatty acids, fibers, minerals and vitamins.

The Year 2016 was declared as the International Year of Pulses by the sixty eighth session of the United Nations General Assembly on December 20, 2013. The Food and Agriculture Organization (FAO) of the United Nations has been nominated to declare a year for pulses. At the global level, pulses are the second most important group of crops after cereals. The global pulses production was 71 million tonnes from an area of 79 million hectare with an average yield of 910 kg per ha during 2015-16 (Anon., 2016b) [3]. India is the largest producer and consumer of pulses in the world contributing around 25-28 per cent of the total global production. Globally 90 per cent of the redgram, 75 per cent of bengalgram and 37 per cent of lentil area is contributed by India. Pulses are the basic ingredient in the diets of a vast majority of the Indian population, as they provide a perfect mix of vegetarian protein component of high biological value when supplemented with cereals. The country grows a variety of pulse crops such as bengalgram, redgram, greengram, blackgram, dry peas, lentils, etc. under a wide range of agro-climatic conditions.

Karnataka is one of the major pulses growing state in the country. Pulses are grown in an area of 27.37 lakh hectare with the production of 10.18 lakh tonnes with a productivity of 599 kg per hectare during 2015-16. Major pulses grown in the state are Redgram, Bengalgram, Greengram and Blackgram. These four pulses accounted 84.01 per cent of total pulses area and 91.34 per cent of state total pulses production during 2015-16. In pertain to study area, Vijayapura occupies highest area under cultivation of pulses with an area of 16.88 per cent to the total state area under pulses cultivation followed by Gadag (7.04%), Bagalkot (5.83%), Belagavi (5.51%), Dharwad (4.86%) and Haveri (0.45%). Among the northern districts Vijayapura stand first with a production of 11.51 per cent (1,17,215 tonnes) followed by

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Bagalkot (6.41%), Belgaum (3.54%), Dharwad (3.64%), Gadag (3.22%) and Haveri (0.34%) (DES, Karnataka 2016).

The major causes for low production of pulses are shortage and lack of timely availability of quality seeds, cultivation of pulses on marginal and sub-marginal lands, deficient/depleted in nutrients with low inputs, lack of appropriate pulse production and protection technologies, lack of information related to pest biology, pulse growing land is deficient in water holding capacity making them vulnerable to heat stress resulting in terminal drought and poor post-harvest technology, storage infrastructure (Sharma *et al.*,2012). In general, the pulses production is not keeping pace with the domestic requirements and is a matter of concern.

Keeping in view of the above issue having importance in pulses production the present study is focusing on the trends in area, production and productivity of major pulses in Karnataka in comparison with India.

Methodology

Growth rate in area, production, productivity, import and export of selected pulse crops were computed for a period of 36 years from 1980 to 2016 depending upon the availability of data. The linear, log-linear, exponential and power functions are some of the important functional forms employed to study the growth rates. Different functional forms were tried in the past for working out the growth rates in area, yield and production by Chengappa (1981) [5], Sikka *et al.* (1985) and Bieche *et al.* (1992). Some of the important forms tried were the linear growth model ($Y = a + bt$), exponential function ($Y = ab^t$) and quadratic function ($Y = a+bt+ct^2$). However, it was found that the exponential form of the function $Y_t = ab^t$ is the better and most frequently used one. In the present study, compound growth rates in area, production, productivity, were estimated by specifying the following relationship.

$$Y_t = ab^t U_t \dots\dots\dots (1.1)$$

Where,

Y_t = area, production, and productivity in the year 't'

t = year which takes value 1, 2, n

U_t = disturbance term in year 't'

'a' and 'b' are parameters to be estimated.

The equation (1.1) was transformed into log- linear form and written as:

$$\text{Log } Y = \text{log } a + t \text{ log } b + \text{log } U_t \dots\dots\dots (1.2)$$

Equation (1.2) was estimated by using ordinary least square (OLS) technique.

Compound growth rate (g) was then estimated by the identity given in equation (1.3).

$$g = (b-1) 100 \dots\dots\dots (1.3)$$

Where,

g = estimated compound growth rate in per cent per annum.

b = antilog of log b

The standard error of the growth rate was estimated and tested for its significance with 't' statistic.

Result and Discussion

Growth rate of area, production and productivity of major pulses in Karnataka

The result of compound growth rate of area, production and productivity of individual as well as total pulses in Karnataka presented in Table.1 and Fig. 1 The growth in area, production and productivity of redgram in Karnataka were found positive and significant in all the period except productivity (-1.95%) in overall period. The growth in area, production and productivity of bengalgram was found positive in all the period except productivity (-3.13%) in overall. Further, growth in production and productivity was positive and significant in all the period. The growth rate pertain to greengram crop found a mixed growth trend with positive and significant growth in area (5.81%) and production (8.79%) in period-I but negative growth in productivity (-6.40%). Whereas, the area, only registered positive growth (1.10%) but production (0.34%) and productivity (-4.38%) found negative. The greengram performance in entire period showed that the area (2.19%) and production (0.34%) found positive growth but productivity (-4.87%) registered negative growth. In case of Blackgram the growth of area (6.26%) and production (6.02%) found positive in period-I but it was negative growth in productivity (0.03%). However, the growth of area, production and productivity in period-II found negative. Whereas, the growth performance of area (2.08%), production (2.02%) and productivity (0.02%) in entire period was positive but the growth of area was negligible. In pertain to total pulses scenario in Karnataka revealed that the growth in area, production and productivity were positive in all the period except productivity (-0.82%) in period-I. It is important to highlight that though the growth rates of productivity is found negative but the production found positive in period-I.

Table 1: Growth rate of area, production and productivity of major pulses in Karnataka (Per cent/annum)

Crops	Particulars	Karnataka		
		Period-I	Period-II	Over all
Redgram	Area	3.64***	3.18***	2.11***
	Production	1.59**	0.34***	3.39***
	Productivity	-1.95	2.97***	1.24**
Bengalgram	Area	5.39***	6.75***	5.92***
	Production	2.09	8.77***	7.74***
	Productivity	-3.13*	1.83***	1.73**
Greengram	Area	5.81***	1.10**	2.19***
	Production	8.79***	-0.94	0.34
	Productivity	-6.40***	-4.38***	-4.87***
Blackgram	Area	6.26***	-0.99*	2.08***
	Production	6.02***	-1.74	2.02***
	Productivity	-0.03	-0.74	0.02
Total Pulses	Area	0.89*	2.08***	1.49***
	Production	0.22	4.05***	2.96***

	Productivity	-0.82	1.92***	1.42***
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Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016 ***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

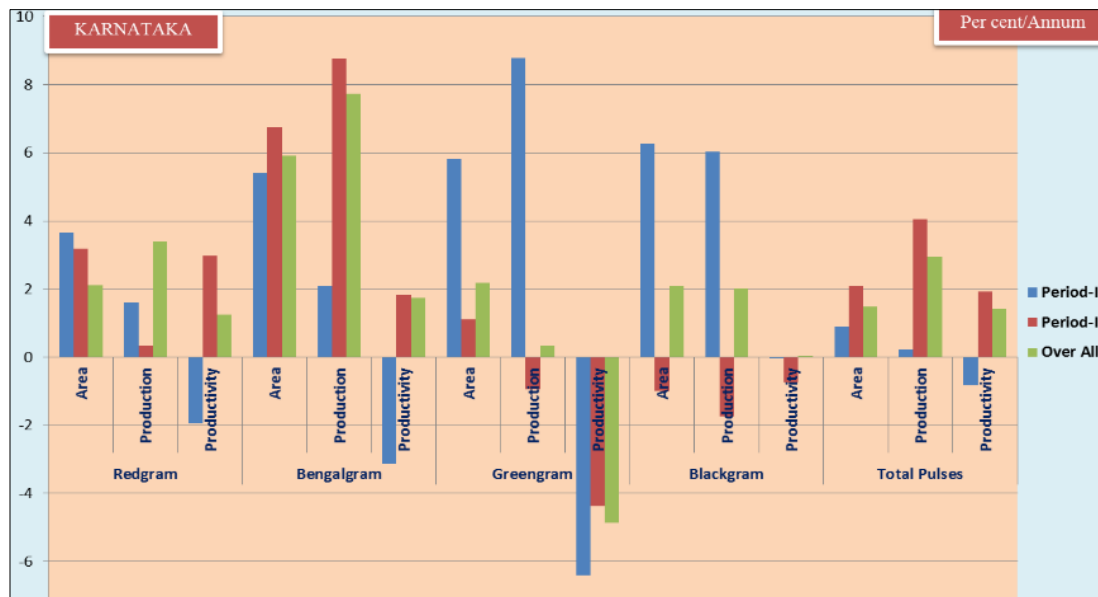


Fig 1: Growth rate of area, production and productivity of major pulses in Karnataka

Growth rate of area, production and productivity of major pulses growing states of India

The results of compound growth rate analysis of area,

production and productivity of individual as well as total pulses in the major pulses growing states of India presented in Table 4.2 to 4.3 (Fig.2)

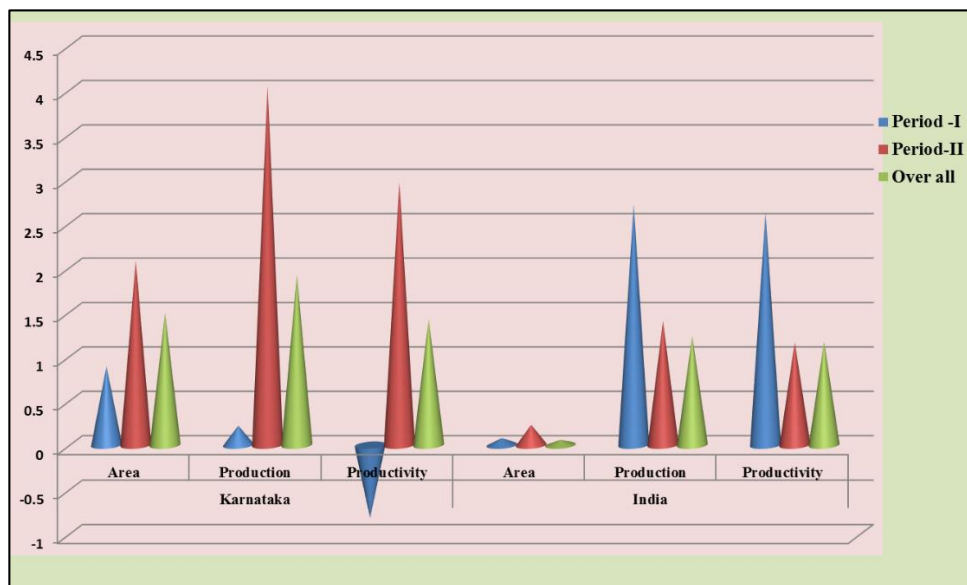


Fig 2: Growth rate of area, production and productivity of total pulses in Karnataka and India

Redgram

Maharashtra state showed positive growth rate in area, production and productivity in all periods. However, state like Madhya Pradesh, Rajasthan, Uttar Pradesh and Tamil Nadu showed mixed trend of growth in area, production and productivity.

Andhra Pradesh state found positive and significant in all the period except productivity (-0.86%) in period-I. Similarly Odisha state registered positive growth in all the period except negative growth of area (-0.78%) in period-II. The Karnataka state showed positive growth in area, production and productivity in all the period except productivity (-1.95%) in period-I which found negative growth.

Bengalgram

The area, production and productivity of bengalgram in Madhya Pradesh was found positive and significant in all the period but the growth of area (0.94%) was not significant in period-I. Similarly the Maharashtra and Andhra Pradesh showed positive growth in all the period. Whereas, Rajasthan, Uttar Pradesh and Tamil Nadu showed the mixed trend of growth in area, production and productivity.

The bengalgram growth performance pertain to Karnataka and Odisha showed positive growth in all the period except area (0.31%) in overall period and productivity (-3.13%) in period-I found negative in Odhisa and Karnataka respectively. However, the country as a whole the growth performance of bengalgram in area, production and productivity found

positive in all the period except area (-1.09%) in period-I showed negative trend.

Greengram

The growth performance of area, production and productivity of greengram in Rajasthan state (Table 4.5) showed positive growth in all the period and it found that there is significant growth in area and production. Madhya Pradesh state showed positive and significant growth in all the period but the growth of area in period-I (-3.38%), period-II (-0.098%) and overall period (-2.25%) showed negative growth. Whereas, the production in period-I (0.14%) found positive but it was found negative in overall period (-0.90%).

The states like Maharashtra, Uttar Pradesh, Andhra Pradesh and Odisha state pertain to overall period showed negative growth in area (-3.59%), production (-5.94%) and productivity (-2.45%). Tamil Nadu states showed positive growth in all the period except productivity (-0.34%) in period-II. In case of Karnataka the growth rate of area showed positive in all the period but the productivity of greengram found negative in all the period.

For the country as a whole (Table.4.5) the area (0.59%), production (0.53%) and productivity (0.23%) increased marginally in the overall study period.

Blackgram

The growth in production and productivity found positive and significant in period-II and overall period in Madhya Pradesh states but the growth of area (-1.02%) in period-I and (-0.98%) in overall period found negative.

The growth performance of blackgram in area, production and productivity Uttar Pradesh is the only state registered positive and significant growth in all the period but the other all the major pulses producing states (Table 4.5) showed mixed trend of growth in area, production and productivity.

The country as a whole showed positive growth rate in area, production and productivity in all the periods. It is worth noting that the productivity of blackgram in period-I (4.38%), period-II (0.69%) and productivity (1.05%) found positive and significant.

Total pulses

The performance of total pulses in major pulses producing

state depicted in Table 4.5. The growth performance of total pulses in Maharashtra, Andhra Pradesh and country as a whole showed positive growth area, production and productivity in all the period.

Madhya Pradesh states showed both positive and negative growth in area and production but pertain to productivity, showed positive and significant in all the period. Rajasthan state register negative growth in area (-2.52%) and production (-1.45%) in period-I and the other study period found positive but not significant. Whereas, productivity found positive in all the period. In case of Uttar Pradesh state, area (0.36%), production (2.53%) and productivity (2.25%) in period-I found positive but in period-II and overall study period showed negative growth.

Odhisa and Tamil Nadu states, showed mixed trend of growth in area, production and productivity. In case of Karnataka the growth rate of total pulses in area, production and productivity showed positive in all the period except productivity (-0.82%) in period-I.

The country as a whole showed positive growth in area, production and productivity in all the period but it is worth noting that the production and productivity found positive and significant in all the period.

To examine the state wise performance of pulses according to the positive and negative growth direction in area, production and productivity. Table 4.6 throws light on the directional shift in growth in the major pulses producing states.

The bengalgram performance in overall period showed the positive direction in Madhya Pradesh and remaining pulses showed negative direction. The productivity of redgram in Madhya Pradesh showed negative direction and all the major pulses showed the positive direction. In case of Rajasthan state, none of the pulses showed negative direction in productivity. The growth direction of major pulses in Maharashtra during overall period all the pulses showed positive direction in production and productivity.

The states like Uttar Pradesh, Odhisa and Karnataka showed the mixed type of direction in the overall period. The productivity performance of all the major pulses in Tamil Nadu and Andhra Pradesh registered positive direction. The country as a whole, none of the pulses showed negative direction in area, production and productivity.

Table 2: Growth rate of area, production and productivity of major pulses growing states of India

Crops	Particulars	Madhya Pradesh			Rajasthan			Maharashtra		
		A	P	Y	A	P	Y	A	P	Y
Redgram	Period -I	-1.89***	5.11**	7.14	-3.60	0.60	5.22	3.06***	4.86***	1.74
	Period-II	0.59	-0.88	-1.47***	-2.40***	-0.56	1.88*	0.59***	2.73***	2.12***
	Over all	-0.71**	-1.34***	-0.63*	-1.56***	1.07	2.60	1.53***	2.52***	0.97***
Bengalgram	Period -I	0.94	3.54**	2.54*	-3.77	-3.27	0.51	3.93***	7.14**	3.08
	Period-II	1.11***	2.45***	1.32***	-0.34	0.44	0.78	3.92***	6.02***	2.02***
	Over all	1.12***	2.93***	1.80**	0.61	-0.09	0.51	3.74***	6.07***	2.50***
Greengram	Period -I	-3.38***	0.14	3.64*	3.13*	10.31	6.92	4.17***	10.85***	6.40***
	Period-II	-0.098	1.09	1.19***	4.89***	8.92***	2.56	-2.87***	-2.84	-0.24
	Over all	-2.25	-0.90	1.37***	5.42***	9.52***	3.11	-0.62	0.98	1.06**
Blackgram	Period -I	-1.02	1.15	2.49	0.03	-0.21	-0.24	-0.32	4.43*	4.57***
	Period-II	0.33	1.83**	1.49***	0.37	2.13	1.76**	-1.56**	-1.71	0.11
	Over all	-0.98***	0.79**	1.81***	0.42	2.04	1.62**	-0.54	0.90	1.47
Total Pulses	Period -I	-0.44	2.78**	3.24**	-2.52	-1.45	1.10	2.01***	5.96***	3.87***
	Period-II	0.16	-0.56	1.40***	0.59	1.53	1.89*	0.22	2.28***	2.05***
	Over all	-0.028	0.85	1.93***	0.46	1.23*	0.90	0.74***	2.76***	2.00***

Note: Period-I = 1980 to 1990, Period-II = 1991 to 2016 and Over all = 1980 to 2016

A: Area, P: Production, Y: Yield (Productivity)

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

Table 2: Contd.. (Per cent/Annum)

Crops	Particulars	Uttar Pradesh			Andhra Pradesh			Odisha		
		A	P	Y	A	P	Y	A	P	Y
Redgram	Period -I	-0.53	0.27	0.79	4.89***	4.26*	-0.86	6.77***	11.68***	4.58***
	Period-II	-2.50	-3.68	-1.21	1.90***	4.52***	2.57***	-0.78	0.40	1.13**
	Over all	-1.74	-3.00***	-1.27***	2.28***	5.13***	2.73***	0.53*	1.45***	0.80***
Bengalgram	Period -I	-0.541	0.27	0.79	0.55	3.63	2.96	0.33	2.98**	2.68*
	Period-II	-2.50***	-3.68***	-1.26***	10.77***	15.02	3.38***	1.32**	2.46***	1.08***
	Over all	-1.72***	-3.11***	-1.22	9.42***	14.49***	4.65***	-0.31	0.42	0.75***
Greengram	Period -I	-0.57	1.17	1.71	-0.11	5.30	5.42**	0.26	1.20	0.92
	Period-II	-0.41	-0.95	0.66	-1.84***	-0.89	1.13	-1.18	-1.65	-0.48
	Over all	-2.04***	-0.95**	1.16***	-1.22***	-0.41	0.91**	-3.59***	-5.94***	-2.45***
Blackgram	Period -I	2.40**	6.90**	4.40**	8.42***	17.92***	8.75***	3.14***	4.17***	1.38
	Period-II	3.40***	5.04***	1.58***	-1.40***	-0.58	0.76**	-4.33***	-5.79***	-1.53***
	Over all	3.61***	6.18***	2.47***	1.49***	1.88***	0.37	-5.39***	-7.59***	-2.28***
Total Pulses	Period -I	0.36	2.53	2.25	0.70	6.46***	5.72***	2.12***	4.34***	2.16
	Period-II	-0.98***	-1.44***	-0.10	0.67**	3.91***	3.21***	-1.73***	-2.89	0.48
	Over all	-0.69***	-0.72***	0.19	0.98***	3.79***	2.78***	-3.21***	-3.80***	-0.43

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016 A: Area, P: Production, Y: Yield (Productivity) ***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 2: Contd...

Crops	Particulars	Tamil Nadu			Karnataka			India		
		A	P	Y	A	P	Y	A	P	Y
Redgram	Period -I	6.42**	12.04***	5.25**	3.64***	1.59**	-1.95	2.44***	3.51***	1.07
	Period-II	-4.65***	-3.30***	1.00**	3.18***	0.34***	2.97***	-0.01	0.93***	0.55
	Over all	-3.40***	-2.42***	0.81**	2.11	3.39***	1.24**	0.46**	0.67***	0.02
Bengalgram	Period -I	-5.36*	-4.44	0.95	5.39***	2.09	-3.13*	-1.09	0.88	1.99*
	Period-II	0.19	0.05	-0.10	6.75***	8.77***	1.83*	1.43***	2.40***	0.94***
	Over all	-0.41	-0.27	0.14	5.92***	7.74***	1.73**	0.61***	1.80***	1.17***
Greengram	Period -I	3.08	7.19**	4.08**	5.81***	8.79***	-6.40	2.07***	4.59***	2.48*
	Period-II	1.64***	1.32	-0.34	1.10**	-0.94	-4.38	-1.93	0.55	0.41
	Over all	1.77***	2.79***	1.07**	2.19***	-0.34	-4.87	0.59	0.53	0.23
Blackgram	Period -I	7.74***	13.89***	5.57*	6.26***	6.02***	0.03	2.11***	6.57	4.38***
	Period-II	-0.46	0.88	0.02	0.99*	1.74	-0.74	0.01	0.65*	0.69**
	Over all	0.59	2.14	1.10	-2.03***	2.02***	0.02	0.20*	1.19***	1.01**
Total Pulses	Period -I	5.87***	10.04***	3.94***	0.89	0.22	-0.82	0.08	2.71**	2.62***
	Period-II	-0.42	-0.23	0.16	2.08***	4.05***	2.96***	0.23	1.40***	1.16***
	Over all	-0.29	0.44	0.71**	1.49***	1.92***	1.42***	0.06	1.23***	1.17***

Note: Period-I = 1980 to 1990, Period-II =1991 to 2016 and Over all = 1980 to 2016 A: Area, P: Production, Y: Yield (Productivity) ***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 3: Direction of growth in area, production and productivity of major pulses growing states of India

States	Period	Area		Production		Productivity	
		Positive	Negative	Positive	Negative	Positive	Negative
Madhya Pradesh	Over all (1980 to 2016)	Bengalgram***	Redgram**, Greengram, Blackgram*** and Total Pulses	Bengalgram***, Blackgram** and Total Pulses	Redgram***, Greengram	Bengalgram***, Greengram***, Blackgram*** and Total Pulses	Redgram*
Rajasthan	Over all (1980 to 2016)	Bengalgram, Greengram***, Blackgram and Total Pulses	Redgram	Redgram, Greengram***, Blackgram and Total Pulses*	Bengalgram	Redgram, Bengalgram, Greengram, Blackgram and Total pulses	—
Maharashtra	Over all (1980 to 2016)	Redgram***, Bengalgram*** and Total pulses	Greengram and Blackgram	Redgram, Bengalgram, Greengram, Blackgram and Total pulses	—	Redgram, Bengalgram, Greengram, Blackgram and Total Pulses	—
Uttar Pradesh	Over all (1980 to 2016)	Blackgram***	Bengalgram***, Greengram***, Redgram and Total Pulses***	Blackgram***	Redgram***, Bengalgram***, Greengram and Total pulses	Greengram***, Blackgram*** and Total pulses	Redgram***, Bengalgram
Andhra Pradesh	Over all (1980 to 2016)	Redgram***, Bengalgram***, Blackgram*** and Total Pulses	Greengram***	Redgram***, Bengalgram***, Blackgram and Total Pulses	Greengram	Redgram***, Bengalgram***, Greengram***, Blackgram and Total Pulses***	—
Odisha	Over all (1980 to 2016)	Redgram*	Bengalgram, Greengram***, Blackgram*** and Total Pulses***	Bengalgram	Redgram*, Greengram***, Blackgram*** and Total pulses	Redgram*** and Blackgram***	Greengram*** and Bengalgram* and Total Pulses

Note: ***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Table 3: Contd...

States	Period	Area		Production		Productivity	
		Positive	Negative	Positive	Negative	Positive	Negative
Tamil Nadu	Over all (1980 to 2016)	Greengram*** and Blackgram	Redgramm ***, Bengalgram and Total Pulses	Greengram***, Blackgram and Total Pulses	Redgramm *** and Bengalgram	Redgramm**, engalgram, Greengram** Blackgram and Total Pulses**	—
Karnataka	Over all (1980 to 2016)	Redgram, Bengalgram*, Greengram***, and Total Pulses	Blackgram	Redgram***, Bengalgram***, Total Pulses***	Greengram *** and Blackgram	Redgram**, Bengalgram**, Blackgram and Total Pulses***	Greengram***
India	Over all (1980 to 2016)	Redgram**, Bengalgram***, Greengram, Blackgram and Total Pulses	—	Redgram***, engalgram***, Greengram, Blackgram*** and Total Pulses	—	Redgram, Bengalgram***, Greengram, Blackgram** and Total pulses***	—

Note: ***Significant at 1% level, **Significant at 5% level and *Significant at 10% level.

Conclusion

The results of compound growth rate in area, production and productivity of total pulses in Karnataka and India revealed that the growth in area, production and productivity were positive in all the periods in Karnataka except area in overall period. However, for the country as a whole the growth rate of area, production and productivity was found positive in all the periods. It is important to note that the area under cultivation of pulses is increasing marginally but not significantly. Whereas, the production and productivity were found significant in all the periods. Pulses have been found to be preferred over coarse grains. Since the yield of pulses is stagnant vis-à-vis other crop. In the light of high population growth, poor production performance has resulted in reduction in per capita availability of pulses. Hence, the efforts need to be made for creation of necessary infrastructure like government assured procurement centre and storage facility and efficient execution of pulses development schemes like National Food Security Mission (NFSM) and Accelerated Pulses Production Programme (A3P) to provide favorable conditions for pulses production.

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