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## Trends analysis in area, production and productivity of major kharif crops in Chhattisgarh State of India

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### Abstract

The present study was conducted with a view to analyze growth and trend in area, production and productivity of major crops of Chhattisgarh. The scope of this study was to determine/ assess the growth pattern in the context of total cultivable area, gross production and yield rate which has been followed by some economically important kharif crops of our country such as Paddy, Pigeonpea, Maize, Green Gram, Sesamum, Soybean and Black gram. Collecting time series data from 2001-2022 (21 years) of those crops from reliable source and using semi-log trend function here the researchers tried to find out the trend and estimate the growth rate of area, production and yield of the abovementioned crops. The compound growth rate as well as trend analysis indicated that the production of rice during 2001-2022 was increased due to the corresponding increase in per hectare yield of rice crop in Chhattisgarh. It was revealed from the results that area, production and yield of pulse were decreased over the time. The results shows that area, production and yield of paddy was increasing a rate of 0.0036, 0.026 and 0.023 percent per annum, respectively, whereas, the area, production and yield of soybean was decreasing. The growth rate for area, production and productivity for some crops are positive and instability indices are very low which also indicates less risk in growing this crop in future too. The production and productivity of the wheat crop have increased during the period under review due to the combine effects of area and productivity.

**Keywords:** Compound growth rate, growth trend, production, productivity

### 1. Introduction

After independence, India has experienced several phases in agricultural development, and the most spectacular was the green revolution. In the context of agriculture, cropping intensity, by the side of cropping pattern, plays the significant role in production system since the cultivable land areas have endlessly been decreasing. Such constant diminution in cultivable land has been exerting undesirable impact on the growth in agricultural sector, resulting in recent declining growth in the sector, according to the law of marginal diminishing return. Per capita agricultural land came down to 0.056 hectare in 2011 from 0.17 hectare in 1961. Rapid population growth, along with unplanned urbanization, causes the areas of cultivable land to be used for non-agricultural purpose, especially for building residence for increasing population. Statistics suggest that between the periods from 1961 to 2007, the agriculture experienced a twofold reduction in the availability of cultivable land. Production during this period increased due mainly to the use of input by the farmers at a higher rate on the same piece of land.

This study was conducted to observe the growth of production of the above mentioned crops over the years whether it is significant or not. Additionally it was intended to observe the pattern of growth of these crops over time whether it has used the endowments efficiently to achieve the maximum/ optimum production. As these crops play very important role for the betterment of our economy, the study has tried to find the lapses in the part of Government's Policy supports as well as in the part of individuals'/farmers' initiatives where insufficient growth has been experienced. Finally, the research work has tried to draw some policy recommendation to all stakeholders to acquire the intended growth to achieve the desired outcome/ optimum level of production of these economically important crops. using conservative treatments such as belly bandages/abdominal bandages, injections, or the application of irritants around the hernia ring. When the hernia is big and unreducible, radical surgery is required (Kumar and Amresh, 1996) [6].

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## 2. Materials and Methods

The data used for the analysis are accumulated from various issues of statistics department of Chhattisgarh. A time series data from 2001-2022 (21 years) regarding the area, production and productivity of major crops (Paddy, Pigeonpea, Maize, Green Gram, Sesamum, Soybean and Black gram) were collected from the above mentioned source. The following semi-log trend function was used to find out the trend and estimate the growth rate of area, production and yield of major crops of Chhattisgarh.

$$Y = \alpha \beta^t$$

$$\text{Log } Y = \log \alpha + t \log \beta$$

Where,

Y= Area/production/productivity of major crops

$\alpha$ = Constant

$\beta$ = Regression coefficient

t= time in year

$$\text{Compound growth rate (\%)} = (\text{Antilog } \beta - 1) \times 100.$$

Where,

b = regression coefficient

$$\text{Coefficient of variation} = \text{standard variation} \div \text{mean} \times 100$$

### Instability index

Cuddy Della Valle 1978) is a modification of coefficient of variation to accommodate trend present in the data, which is commonly present in economic time series data. This method is superior over the scale dependent measures such as standard deviation. The Cuddy Dela Valle index (CDVI) is calculated as follows:

$$\text{Cuddy Dela Valle index (\%)} = \text{Coefficient of Variation } R^2 = \text{Coefficient of multiple determination}$$

The ranges of CDVI (Sihmat, 2014) are given as follows:

Low instability = between 0 to 15

Medium instability = greater than 15 and lower than 30

High instability = greater than 30

## 3. Results and Discussion

The compound growth rate is calculated for the all seven kharif crops to know the variation in growth rate for the period of time. For studied the trends in the area, production and productivity of kharif crops for the different district of Chhattisgarh states were calculated for the period of 21 years i.e. 2001-2022. The CAGR is calculated for all the individual two decades and the whole period from CAGR results, it is observed that the accelerating growth rate in area, production and productivity for the major kharif crop into consideration. But there are some negative trends also observed in somecrops. For the above period, the average CAGR in major kharif crops in Chhattisgarh states for Paddy as 0.0036, 0.026 and 0.023 percent per annum, for Pigeonpea 0.048, 0.16 and 0.11 percent per annum, for Maize -0.041, -0.052 and -0.010 percent per annum, for green gram -0.058, -0.036 and 0.024 percent per annum, for sesamum -0.024, 0.002 and 0.028 percent per annum, for soybean 0.07, 0.09 and 0.01 percent per annum and for blackgram -0.020, -0.01 and 0.009 percent per annum is observed in the area, production and productivity.

### 3.1 The CGR calculated for the Paddy crop during the year 2001-2022

Table 1 represents the CAGR for the Paddy in different major districts of state. Table indicate that Rajnandgaon registered significant positive growth rate of 1.40 percent per annum whereas Raipur shows significant decline in area at the rate of 5.58 percent per annum. The highest significant growth in paddy production to the tune of 7.90 percent per annum was recorded in Korba district. Whereas, Narayanpur showed the significant decline in paddy production at the rate of 5.24 percent per annum. Raipur registered significant increase by 10.45 percent per annum, whereas contrast to this, Kondagaon district significant decline in paddy productivity has been observed wherein it decreased at the rate of 1.43 percent per annum to reach the level of 1361.06kg/ha (2001-02) from the level of 1361kg/ha in the year 2021-22 respectively.

**Table 1:** Compound annual growth rate (CAGR) of area, production and productivity of paddy in different districts 2001-02 to 2021-22

Districts	Area			Production			Productivity		
	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)
	(Ha.)			(Mt.)			(kg/ha)		
Raipur	507.39	160.83	-5.58%***	205.4929	475.72	4.29%	405.00	2957.90	10.45%
Balodabazar	219.14	229.92	0.24%	377.36	607.57	2.41%	1773.00	2642.53	2.02%
Gariyaband	120.5	121.73	0.05%	180.01	260.14	1.86%	1638.00	2137.04	1.34%
Mahasamund	230.88	245.31	0.30%	112.9003	410.96	6.67%	489.00	1675.28	6.35%
Dhamtari	129.01	139.9	0.41%	125.3977	432.62	6.39%	972.00	3092.39	5.96%
Durg	425.44	133.34	-5.64%**	219.1016	329.92	2.07%	515.00	2474.30	8.16%
Balod	170.1	176.25	0.18%	339.53	570.34	2.63%	2112.00	3235.95	2.16%
Bemetara	152.93	187.03	1.01%	250.48	451.88	2.99%	1803.00	2416.06	1.47%
Rajnandgaon	248.95	328.71	1.40%	210.8606	633.56	5.65%	847.00	1927.40	4.20%
Kabirdham	95.85	132.58	1.64%	132.73	163.77	1.06%	1551.00	1235.28	-1.13%***
Bilaspur	310.57	172.42	-2.90%*	193.7956	450.34	4.31%	624.00	2611.91	7.42%
Mungeli	106.88	121.5	0.64%	239.57	318.64	1.44%	2374.00	2622.52	0.50%
Janjgir	250.95	258.67	0.15%	165.37605	521.65	5.91%	659.00	2016.64	5.75%
Korba	109.32	112.97	0.16%	61.2192	280.22	7.90%	560.00	2480.46	7.73%
Raigarh	235.63	225.49	-0.22%	113.80929	426.80	6.83%	483.00	1892.78	7.07%
Jashpur	178.79	185.05	0.17%	120.86204	277.31	4.24%	676.00	1498.55	4.06%
Sarguja	306.19	113	-4.86%*	193.20589	183.79	-0.25%**	631.00	1626.45	4.85%
Surajpur	106.93	112.72	0.26%	151.19	185.73	1.03%	1487.00	1647.75	0.51%
Balrampur	78.49	91.33	0.76%	144.38	172.90	0.91%	1855.00	1893.17	0.10%

Korea	68.41	73.95	0.39%	45.62947	165.67	6.66%	667.00	2240.30	6.25%
Bastar	257.69	127.4	-3.46%**	212.85194	209.48	-0.08%*	826.00	1644.26	3.50%
Kondagaon	99.58	108.4	0.43%	142	147.54	0.19%	1815.00	1361.06	-1.43%
Narayanpur	24.17	21.32	-0.63%	81	27.59	-5.24%***	1517.00	1294.06	-0.79%*
Dantewada	207.469	71.52	-5.19%	34.52	110.05	5.97%	855.00	1538.73	2.98%
Sukma	73.09	86.73	0.86%	152.06	158.84	0.22%	2246.00	1831.43	-1.02%***
Bijapur	60.84	73.84	0.97%	150.54	123.22	-1.00%**	1970.00	1668.74	-0.83%
kanker	161.38	169.82	0.26%	132.49298	352.16	5.01%	821.00	2073.75	4.74%

\*, \*\*, \*\*\* indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

### 3.2 The CAGR calculated for the Pigeonpea crop during the year 2001-2022

Table 2 represents the CAGR for the pigeonpea in different major districts of state. Table indicate that Kabirdham district registered significant positive growth rate of 1.75 percent per annum whereas Mahasamund shows significant decline in area at the rate of 13.40 percent per annum. the highest significant growth in pigeonpea production to the tune of 5.83

percent per annum was recorded in Jashpur district. Whereas, Mahasamund showed the significant decline in pigeonpea production at the rate of 12.76 percent per annum. District Jashpur registered significant increase by 4.06 percent per annum, whereas contrast to this, Narayanpur district significant change in pigeonpea productivity has been observed wherein it decreased at the rate of 100 percent per annum.

**Table 2:** Compound annual growth rate (CAGR) of area, production and productivity of pigeonpea in different districts of Chhattisgarh during 2001-02 to 2021-22

Districts	Area			Production			productivity		
	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)
	(Ha.)			(Mt.)			(kg/ha)		
Raipur	2.615	0.16	-13.04%*	0.705	0.06	-11.59%	270	375	1.66%
Balodabazar	1.43	0.32	-7.21%	0.64	0.1	-8.86%	450	312.5	-1.81%*
Gariyaband	0.66	0.42	-2.23%	0.24	0.16	-2.01%	368	380.9524	0.17%
Mahasamund	0.888	0.05	-13.40%	0.307	0.02	-12.76%*	346	400	0.73%
Dhamtari	0.176	0.03	-8.47%	0.051	0.01	-7.82%	290	333.3333	0.70%
Durg	6.191	1.34	-7.37%	1.937	0.66	-5.24%***	313	492.5373	2.29%
Balod	0.57	0.22	-4.65%***	0.32	0.11	-5.20%	554	500	-0.51%
Bemetara	3.14	3.73	0.86%	1.62	1.47	-0.48%	515	394.1019	-1.33%
Rajnandgaon	5.625	3.63	-2.17%	2.288	2.3	0.03%	407	633.6088	2.24%***
Kabirdham	4.71	6.66	1.75%	2.75	3.19	0.74%	583	478.979	-0.98%
Bilaspur	3.295	0.14	-14.61%	1.48	0.07	-14.15%	449	500	0.54%
Mungeli	1.75	1.18	-1.95%	1.2	0.63	-3.17%	684	533.8983	-1.23%
Janjgir	0.855	0.29	-5.26%	0.435	0.16	-4.88%	509	551.7241	0.40%
Korba	0.696	0.56	-1.08%	0.307	0.3	-0.12%	441	535.7143	0.98%
Raigarh	1.254	1.66	1.41%	0.496	0.98	3.46%	396	590.3614	2.02%**
Jashpur	3.084	4.32	1.70%	1.59	4.94	5.83%**	516	1143.519	4.06%
Sarguja	13.363	3.24	-6.84%***	7.005	1.96	-6.17%	524	604.9383	0.72%
Surajpur	3.96	2.71	-1.88%	2.54	1.75	-1.85%	641	645.7565	0.04%
Balrampur	8.57	4.65	-3.01%	5.45	2.73	-3.40%	694	587.0968	-0.83%
Korea	2.731	3.78	1.64%	1.385	1.85	1.46%	507	489.418	-0.18%*
Bastar	0.975	0.15	-8.93%	0.565	0.08	-9.31%	579	533.3333	-0.41%
Kondagaon	0.16	0.04	-6.70%	0.1	0.02	-7.73%**	601	500	-0.92%
Narayanpur	0.11	0.01	-11.30%	0.06	0	-100.00%	542	0	-100.00%
Dantewada	0.968	0.11	-10.30%*	0.492	0.07	-9.29%	0	636.3636	0
Sukma	0.38	0.13	-5.22%	0.29	0.07	-6.86%	763	538.4615	-1.73%**
Bijapur	0.01	0	-100.00%	0.01	0	-100.00%	667	0	-100.00%
kanker	0.447	0.11	-6.77%***	0.196	0.05	-6.60%	438	454.5455	0.19%

\*, \*\*, \*\*\* indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

### 3.3 The CAGR calculated for the Maize crop during the year 2001-2022

Table 3 represents the CAGR for the Maize in different major districts of state. Table indicate that Bemetara district registered significant positive growth rate of 13.7percent per annum whereas Bilaspur shows significant decline in area at the rate of 11.9 per annum. During the study period, the highest significant growth in Maize production to the tune of

21.7 percent per annum was recorded in Dhamtari district, Whereas Bilaspur showed the significant decline in maize production at the rate of 7.3 percent per annum. Dhamtari registered significant increase by 11.7, percent per annum, whereas contrast to this, districts Korea shows significant change in Maize productivity has been observed wherein it decreased at the rate of 0.2 percent per annum.

**Table 3:** Compound annual growth rate (CAGR) of area, production and productivity of maize in different districts of Chhattisgarh during 2001-02 to 2021-22

Districts	Area			Production			productivity		
	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)
	(Ha.)			(Mt.)			(kg/ha)		
Raipur	0.585	0.06	-10.8%*	0.556	0.22125	-4.5%**	950	3687.5	7.0%
Balodabazar	0.1	0.06	-2.5%	0.16	0.144	-0.5%	1636	2400	1.9%
Gariyaband	6.54	7.04	0.4%	9.86	18.74014	3.3%	1508	2661.952	2.9%
Mahasamund	0.136	0.07	-3.3%	0.149	0.178889	0.9%	1096	2555.556	4.3%**
Dhamtari	0.109	0.61	9.0%	0.099	5.062299	21.7%	908	8298.851	11.7%
Durg	0.281	0.06	-7.4%	0.254	0.195484	-1.3%	904	3258.065	6.6%*
Balod	0.2	0.1	-3.4%**	0.29	0.203704	-1.8%	1615	2037.037	1.2%
Bemetara	0.02	0.26	13.7%	0.03	0.606667	16.2%**	1588	2333.333	1.9%
Rajnandgaon	1.315	0.98	-1.5%	1.32	3.879321	5.5%	1004	3958.491	7.1%**
Kabirdham	2.78	1.48	-3.1%	4.34	3.09	-1.7%	1560	2087.838	1.5%
Bilaspur	4.548	0.36	-11.9%	4.422	0.963243	-7.3%	972	2675.676	5.2%
Mungeli	0.2	0.03	-9.0%	0.36	0.075	-7.5%	1800	2500	1.7%
Janjgir	0.383	0.17	-4.0%**	0.486	0.56913	0.8%	1269	3347.826	5.0%
Korba	4.902	2.72	-2.9%	5.181	6.124964	0.8%	1057	2251.825	3.9%
Raigarh	0.901	1.23	1.6%	1.059	4.296338	7.3%***	1175	3492.958	5.6%***
Jashpur	6.646	5.78	-0.7%	10.039	16.92145	2.6%	1511	2927.586	3.4%
Sarguja	37.317	14.24	-4.7%*	50.437	45.95276	-0.5%	1352	3227.019	4.4%
Surajpur	11.67	12.89	0.5%	20.63	27.1639	1.4%	1768	2107.362	0.9%
Balrampur	18.28	38.05	3.7%	37.69	135.5151	6.6%	2062	3561.5	2.8%
Korea	8.232	5.31	-2.2%	11.127	11.26	0.1%	2041	2120.527	0.2%*
Bastar	13.769	14.8	0.4%	22.508	67.8469	5.7%	1635	4584.25	5.3%**
Kondagaon	8.3	13.19	2.3%	16.95	59.2023	6.5%**	2041	4488.423	4.0%
Narayanpur	1.09	0.97	-0.6%*	2.6	3.242843	1.1%	2381	3343.137	1.7%
Dantewada	7.633	1.7	-7.2%	11.343	6.004678	-3.1%*	1486	3532.164	4.4%
Sukma	2.54	1.24	-3.5%**	4.92	5.187941	0.3%	1938	4183.824	3.9%
Bijapur	0.63	0.39	-2.4%	1.29	1.51125	0.8%	2043	3875	3.3%*
kanker	3.305	4.47	1.5%	3.18	19.94928	1.2%*	1362	4462.926	6.1%

\*, \*\*, \*\*\* indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

**3.4 The CAGR calculated for the green gram crop during the year 2001-2022**

Table 4 represents the CAGR for the green gram in different major districts of state. Raipur district shows significant decline in area at the rate of 12.66percent per

annum while highest significant growth in green gram production to the tune of 4.69 percent per annum was recorded in Jashpur district.

District Raipur registered significant increase by 7.85 percent per annum in productivity.

**Table 4:** Compound annual growth rate (CAGR) of area, production and productivity of green gram in different districts of Chhattisgarh during 2001-02 to 2021-22

Districts	Area			Production			productivity		
	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)
	(Ha.)			(Mt.)			(kg/ha)		
Raipur	0.45	0.03	-12.66%	0.066	0.02	-5.79%	147	666.6667	7.85%
Balodabazar	0.14	0.07	-3.41%	0.04	0.04	0.00%	268	571.4286	3.86%
Gariyaband	0.27	0.01	-15.19%	0.07	0	-100.00%	266	0	-100.00%
Mahasamund	3.123	1.06	-5.26%	0.879	0.26	-5.91%	281	245.283	-0.68%
Dhamtari	0.07	0.02	-6.07%*	0.012	0.01	-0.91%	171	500	5.51%**
Durg	0.285	0	-100.00%	0.044	0	-100.00%	154	0	-100.00%
Balod	0.03	0	-100.00%	0.01	0	-100.00%	220	0	-100.00%
Bemetara	0.05	0.01	-7.73%	0.01	0	-100.00%	211	0	-100.00%
Rajnandgaon	0.721	0.03	-14.70%**	0.126	0.02	-8.79%	175	666.6667	6.92%
Bilaspur	0.049	0	-100.00%	0.008	0	-100.00%	163	0	-100.00%
Mungeli	0.02	0.01	-3.41%	0.01	0	-100.00%	250	0	-100.00%
Janjgir	0.112	0.08	-1.67%	0.018	0.03	2.59%	161	375	4.32%
Korba	0.075	0	-100.00%	0.013	0	-100.00%	173	0	-100.00%
Raigarh	2.084	1.05	-3.37%*	0.462	0.78	2.65%	222	675	5.72%
Jashpur	0.029	0.04	1.62%	0.008	0.02	4.69%***	276	500	3.02%
Sarguja	0.073	0	-100.00%	0.013	0	-100.00%	178	0	-100.00%
Surajpur	0.05	0.1	3.53%	0.01	0.02	3.53%	185	200	0.39%
Balrampur	0.03	0.01	-5.34%	0.01	0.01	0.00%	219	600	5.17%***
Korea	0.031	0.01	-5.50%	0.007	0	-100.00%	226	0	-100.00%

Bastar	0.262	0.01	-15.07%	0.118	0.01	-11.61%*	450	600	1.45%
Kondagaon	0.14	0.05	-5.02%	0.05	0.03	-2.52%	392	600	2.15%*
Narayanpur	0.01	0	-100.00%	0	0	0	390	0	-100.00%
Dantewada	1.427	0.06	-14.65%**	0.492	0.03	-13.05%	345	500	1.87%
Sukma	0.78	0.06	-12.04%	0.41	0.02	-14.02%**	521	333.3333	-2.21%
Bijapur	0.33	0.11	-5.34%	0.13	0.05	-4.67%	390	454.5455	0.77%
kanker	1.042	0.05	-14.09%	0.118	0.03	-6.62%	358	600	2.62%*

\*, \*\*, \*\*\* indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

### 3.5 The CAGR calculated for the sesamum crop during the year 2001-2022

Table 5 represents the CAGR for the green gram in different major districts of state. Table indicate that Balrampur district registered significant positive growth rate of 2.05percent per

annum while during the study period, the highest significant growth in Sesamum production to the tune of 7.84 percent per annum was recorded in Korba district. Narayanpur district registered significant increase by 7.40 percent per annum in productivity.

**Table 5:** Compound annual growth rate (CAGR) of area, production and productivity of Sesamum in different districts of Chhattisgarh during 2001-02 to 2021-22

Districts	Area			Production			productivity		
	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)
	(Ha.)			(Mt.)			(kg/ha)		
Raipur	3.431	0.13	-15.10%**	0.531	0.07	-9.64%	155	538.46	6.42%
Balodabazar	0.83	0.26	-5.64%	0.25	0.09	-4.98%*	300	346.15	0.72%
Gariyaband	1.16	0.07	-13.10%	0.29	0.03	-10.72%	253	428.57	2.67%
Mahasamund	1.177	0.16	-9.50%	0.273	0.07	-6.58%	232	437.50	3.22%**
Dhamtari	0.191	0.02	-10.67%**	0.025	0.01	-4.48%	131	500.00	6.93%
Durg	1.24	0.1	-11.83%**	0.187	0.05	-6.38%**	151	500.00	6.17%
Balod	0.27	0.15	-2.90%	0.07	0.06	-0.77%	265	400.00	2.08%**
Bemetara	0.21	0.11	-3.18%	0.05	0.04	-1.11%	256	363.64	1.77%
Rajnandgaon	0.88	0.37	-4.24%	0.139	0.22	2.32%	158	594.59	6.85%
Kabirdham	0.67	0.15	-7.21%**	0.18	0.05	-6.20%	265	333.33	1.15%
Bilaspur	0.687	0.03	-14.49%*	0.092	0.01	-10.50%	134	333.33	4.66%*
Mungeli	0.06	0.03	-3.41%	0.02	0.01	-3.41%**	288	333.33	0.73%
Janjgir	0.493	0.12	-6.82%	0.082	0.06	-1.55%	166	500.00	5.67%
Korba	1.559	0.96	-2.40%	0.084	0.38	7.84%	150	395.83	4.97%
Raigarh	3.058	2.48	-1.04%	0.503	1.41	5.29%	164	568.55	6.41%**
Jashpur	0.221	0.24	0.41%	0.046	0.1	3.96%**	208	416.67	3.53%
Sarguja	4.707	0.31	-12.72%**	0.791	0.14	-8.29%	168	451.61	5.07%
Surajpur	1.36	1.43	0.25%	0.37	0.52	1.72%	273	363.64	1.44%
Balrampur	2.88	4.32	2.05%*	0.86	1.71	3.50%**	298	395.83	1.43%
Korea	1.56	1.5	-0.20%	0.267	0.44	2.53%	171	293.33	2.73%*
Bastar	0.74	0.09	-10.00%	0.166	0.04	-6.87%**	224	444.44	3.49%
Kondagaon	0.31	0.11	-5.05%*	0.11	0.05	-3.87%	340	454.55	1.46%
Narayanpur	0.03	0.01	-5.34%	0.01	0.01	0.00%	240	1000.00	7.40%**
Dantewada	1.81	0.02	-20.17%**	0.378	0.01	-16.61%	196	500.00	4.79%
Sukma	1.54	0.88	-2.76%	0.38	0.33	-0.70%*	247	375.00	2.11%*
Bijapur	0.06	0	-100.00%	0.02	0	-100.00%	280	0.00	-100.00%
kanker	0.681	0.05	-12.24%**	0.134	0.02	-9.07%	196	400.00	3.63%

\*, \*\*, \*\*\* indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

### 3.6 The CAGR calculated for the soybean crop during the year 2001-2022

Table 6 represents the CAGR for the soybean in different major districts of state. Table indicate that Rajnandgaon district registered significant positive growth rate of 6.69

percent per annum whereas highest significant growth in soybean production to the tune of 8.38 percent per annum was recorded in Rajnandgaon district. Bilaspur registered significant increase by 3.23 percent per annum in productivity.

**Table 6:** Compound annual growth rate (CAGR) of area, production and productivity of soybean in different districts of Chhattisgarh during 2001-02 to 2021-22

Districts	Area			Production			productivity		
	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)
	(Ha.)			(Mt.)			(kg/ha)		
Raipur	0.733	0.08	-10.48%**	0.453	0.09	-7.76%	618	1125.00	3.04%
Balodabazar	-	0.22	-	-	0.18	-	-	818.18	-
Gariyaband	-	0	-	-	0	-	-	0.00	-
Mahasamund	0.011	0	-100.00%	0.007	0	-100.00%	636	0.00	-100.00%

Dhamtari	0	0	-	0	0	-	0	0.00	
Durg	2.554	3.44	1.50%	1.299	2.44	3.20%*	509	709.30	1.67%
Balod	-	0.03	-		0.02			666.67	
Bemetara	-	18.67	-		11.35			607.93	
Rajnandgaon	6.485	23.67	6.69%**	3.817	19.08	8.38%	589	806.08	1.58%
Kabirdham	-	16.29	-		12.17			747.08	
Bilaspur	0.591	0.01	-18.45%***	0.313	0.01	-15.82%	530	1000.00	3.23%
Mungeli	-	2.26	-		2.14			946.90	
Janjgir	0.006	0	-100.00%	0.005	0	-100.00%	667	0.00	-100.00%
Korba	0.002	0	-100.00%	0	0	-	500	0.00	-100.00%
Raigarh	0.186	0	-100.00%	0.069	0	-100.00%	371	0.00	-100.00%
Jashpur	0.011	0	-100.00%	0.007	0	-100.00%	636	0.00	-100.00%
Sarguja	0.062	0	-100.00%	0.032	0	-100.00%	508	0.00	-100.00%
Surajpur	-	0	-	-	0	-	-	0.00	-
Balrampur	-	0.04	-	-	0.02	-	-	500.00	-
Korea	0.005	0	-100.00%	0.005	0	-100.00%	600	0.00	-100.00%
Bastar	0.064	0	-100.00%	0.049	0	-100.00%	766	0.00	-100.00%
Kondagaon	-	0	-	-	0	-	-	0.00	-
Narayanpur	-	0	-	-	0	-	-	0.00	-
Dantewada	0.009	0	-100.00%	0.006	0	-100.00%	667	0.00	-100.00%
Sukma	-	0	-	-	0	-	-	0.00	-
Bijapur	-	0	-	--	0	-	-	0.00	-
kanker	0.084	0.01	-10.09%	0.055	0.01	-8.17%	655	1000	2.14%*

\*, \*\*, \*\*\* indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

### 3.7 The CAGR calculated for the Black gram during the year 2001-2022

Table 7 represents the CAGR for the Black gram in different major districts of state. Table indicate that Dhamtari district registered significant positive growth rate of 0.93percent per

annum, whereas highest significant growth in urd production to the tune of 3.50 percent per annum was recorded in Dhamtari district. District Bilaspur registered significant increase by 6.31percent per annum in productivity.

**Table 7:** Compound annual growth rate (CAGR) of area, production and productivity of blackgram in different districts of Chhattisgarh during 2001-02 to 2021-22

Districts	Area			Production			productivity		
	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)	Initial year (2001-02)	End year (2021-22)	CAGR (%)
	(Ha.)			(Mt.)			(kg/ha)		
Raipur	5.301	0.03	-22.80%**	1.096	0.01	-20.93%	207	333.3333	2.41%
Balodabazar	1.92	1.14	-2.57%	0.82	0.56	-1.89%	426	491.2281	0.71%
Gariyaband	1.71	1.16	-1.92%	0.73	0.52	-1.68%**	426	448.2759	0.26%
Mahasamund	11.794	8	-1.92%	4.507	2.14	-3.66%	382	267.5	-1.77%**
Dhamtari	0.681	0.82	0.93%*	0.196	0.39	3.50%	288	475.6098	2.54%
Durg	2.791	0.07	-16.83%	0.762	0.03	-14.93%	273	428.5714	2.28%
Balod	1.3	0.8	-2.40%	0.4	0.26	-2.13%***	308	325	0.27%
Bemetara	0.36	0.22	-2.43%	0.12	0.09	-1.43%	328	409.0909	1.11%
Rajnandgaon	8.322	1.09	-9.66%***	2.707	0.44	-8.68%	325	403.6697	1.09%
Kabirdham	1.76	0.67	-4.71%	0.64	0.23	-4.99%	362	343.2836	-0.27%
Bilaspur	2.87	0.02	-21.99%	0.422	0.01	-17.07%	147	500	6.31%*
Mungeli	0.09	0.05	-2.90%	0.02	0.01	-3.41%	268	200	-1.45%
Janjgir	1.753	0.35	-7.74%**	0.419	0.12	-6.06%	239	342.8571	1.82%
Korba	5.04	1.67	-5.37%	0.962	0.68	-1.72%	191	407.1856	3.86%
Raigarh	20.028	12.47	-2.34%	3.783	3.12	-0.96%*	189	250.2005	1.41%
Jashpur	16.469	12.1	-1.53%	3.429	5.14	2.04%	208	424.7934	3.63%
Sarguja	16.092	4.67	-6.00%*	4.537	2.83	-2.33%	282	605.9957	3.90%
Surajpur	5.77	4.56	-1.17%	1.69	1.78	0.26%	293	390.3509	1.44%
Balrampur	4.87	3.32	-1.90%	1.8	1.13	-2.30%**	369	340.3614	-0.40%
Korea	4.525	4.23	-0.34%	1.619	1.06	-2.10%	358	250.591	-1.77%
Bastar	12.112	1.72	-9.30%	5.437	0.62	-10.29%	449	360.4651	-1.09%
Kondagaon	7.63	8.64	0.62%	3.03	3.68	0.98%	397	425.9259	0.35%
Narayanpur	1.31	1.34	0.11%	0.45	0.69	2.16%**	345	514.9254	2.02%
Dantewada	1.528	0.42	-6.25%	0.567	0.19	-5.32%	370	452.381	1.01%
Sukma	0.48	0.22	-3.83%	0.22	0.08	-4.93%	449	363.6364	-1.05%***
Bijapur	0.32	0.16	-3.41%	0.1	0.06	-2.52%	323	375	0.75%
Kanker	5.03	3.83	-1.35%*	1.833	1.69	-0.41%	364	441.2533	0.97%

\*, \*\*, \*\*\* indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

#### 4. Conclusion

The compound growth rate as well as trend analysis indicated that the production of rice during 2001- 2022 was increased due to the corresponding increase in per hectare yield of rice in Chhattisgarh. On the other hand, the trend analysis indicated that the production of pigeonpea, greengram, blackgram, sesamum and soybean during the same period was decreased due to the corresponding decrease in per hectare yield of jute in Chhattisgarh.

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