Growth and Instability Analysis of Rice inChhattisgarh: A District Level Study

ABSTRACT

Rice is the crop which cultivated in below sea level as well as at higher altitude. In India farmers mainly depend on rainfall for its production as it depends on weather conditions. Therefore there is a need to study the fluctuation in the production. Fluctuation in growth rate as well as instability affects the price and overall supply of product in the region.Chhattisgarh state contributes 8.1% rice area and 6.2% rice production of the country. Its contribution ~~is very~~ vital in agricultural growth of the country. But, yield of the state is less than the national average yield. Therefore the present study has been undertaken to analyze the growth rate and instability in area, production and yield of rice in Chhattisgarh state. District-wise compound annual growth rate Instabilityindex have been computed for various periods from 2000-01 to 2019-20. The districts have been classified into five classes based ~~for~~ instability. Growth rate ranges from -0.10 to 0.04 for area, 2.02 to 4.01 for production and 1.98 to 4.12 for yield in the state. The highest growth rate was recorded for production in period I while lowest growth rate was recorded for area in period II across the districts and periods. The instability of the state ranges from 0.80 to 1.92 for area; 13.21 to 24.43 for production and 12.97 to 23.73 for yield. Highest instability was observed for yield and lowest instability was recorded for area in period I. None of the districts were classified as very high instability for area, production and yield in all the periods. Similarly none of the districts were classified as medium and high instability for area; and very low instability for production and yield. The study may be useful for planners of Chhattisgarh state for implement the plan for the state at district level based on the results of the study.

Keywords: Rice, Chhattisgarh, growth rate, instability, production, area, yield

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1. INTRODUCTION

Agriculture is one of the most importantfactors in India where more than fifty percent population are associated with agriculture and its related activities directly or indirectly. Agricultural production depends on weather conditions and in India farmers are mainly dependent on rainfall as ~~the~~ technologies developed on research stations is not yet reached on farmer's field in large scale [1].Therefore there is a need to study the fluctuation or growth rate in the production which will ultimately useful in understanding production status at regional level.Fluctuating instability in agriculture increases the risk in farm

production and adversely affects farmers' income. Instability in production affects price stability and it increases vulnerability of low-income households to market [2].

Chhattisgarh state is carved out from the erstwhile Madhya Pradesh in 2000. Rice is one of the vital crop in Chhattisgarh state. Chhattisgarh is the sixth largest producer of rice with the production of 8 million tones contributing 6% of the rice production of the country and forth largest state in terms of rice area contributing 8% area of the country in 2021-22. The yield of the Chhattisgarh state is 2.1 tons/ha which is less than the average yield of the country (2.8 tons/ha). Hence, it is essential to study the trend of area, production and yield of rice over the years to enhance its contribution.

Samal et al.[3] computed the growth rate of production of rice in India for various states. Some studies have been conducted to compute the district wise growth rate and instability of rice [4-10].Gupta et al. [11] studied the growth performance and instability of major cereals in Chhattisgarh; Patel et al. [12] studied the growth performance and instability of oilseeds in Chhattisgarh;Sarva et al. [13] studied the growth rate and instability of major pulses in Chhattisgarh;Chanchal et al.[14] studied the growth rate and instability of linseed for the districts in Chhattisgarh;but could not able to trace the district wise study of growth rate and instability of rice for all the districts inChhattisgarh state from the inception of the state.

Therefore, the present work is undertaken with the objective to study the district wise growth rate and instability of area, production and yield of rice in Chhattisgarh state.

2. MATERIAL AND METHODS

The present study is conducted based on the secondary data on area, production and yield of rice in Chhattisgarh state collected for the year 2000-01 to 2019-20.The district wise data on area, production and yield of rice in Chhattisgarh state was collected from Directorate ofEconomics andStatistics,Department ofAgriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India during the last ten years.

Chhattisgarh state was formed by splitting sixteen districts of Madhya Pradesh in 2000. At present there are thirty threedistricts in the Chhattisgarh state. Chhattisgarh originally had sixteen districts. Two new districts were formed in 2007, nine new districts were formed in 2012, one district was added in 2020 and five new districts were inaugurated in 2022 with a total of 33 districts.The analysis ~~have~~ been done from 2000-01 to 2019-20 from inception of the state.The thirty three districts were merged into sixteen districts. The complete data were divided into three periods namely period I (2000-01 to 2009-10), period II (2010-11 to 2019-20) and period III (2000-01 to 2019-20). Then growth rate and instability were calculated for each of the periods.

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The exponential model used to compute the compound growth rate is as follows [15]:

$$Y = ab^t$$

Taking log to both sides we get,

Log Y = log a + t logb

Here, log a is the intercept and log b is slope.

CGR(r) =[Antilog(log b) -1] × 100

where,

CGR = Compound growth rate

t = time period in year

Y= area/production/productivity

The growth rate was calculated based on three years moving average data [15-17].

To measure the instability in the studied variables, an index of variability i.e. Cuddy-Della Valleindex (CDVI) [18] has been used.

$$CDVI = CV \times \sqrt{(1 - Adj.R^2)}$$

where,

CDVI =Cuddy-Della ValleInstabilityindex (per cent)

CV= Coefficientof variation (per cent)

Adj.R^2=R^2 adjusted for number of predictors in the model

The instability has beenclassified intovery low instability (0-5), low instability (5-15), medium instability (15-30), high instability (30-50) and very high instability (>50) [10-11].

3. RESULTS AND DISCUSSION

The area (million hectare), production (million tons) and yield (t/ha) of rice in Chhattisgarh state from 2000-01 to 2019-20 is depicted in Figure 1. The rice area changed from 3.77 million hectare in 2000-01 to 3.67 million hectare in 2019-20, the rice production 2.37 million tons in 2000-01 increased to 6.77 million tons in 2019-20 and rice yield 0.67 t/ha in 2000-01 increased to 1.85t/ha in 2019-20. During the last twenty years, area remains almost constant, production and yield increased by more than twice.

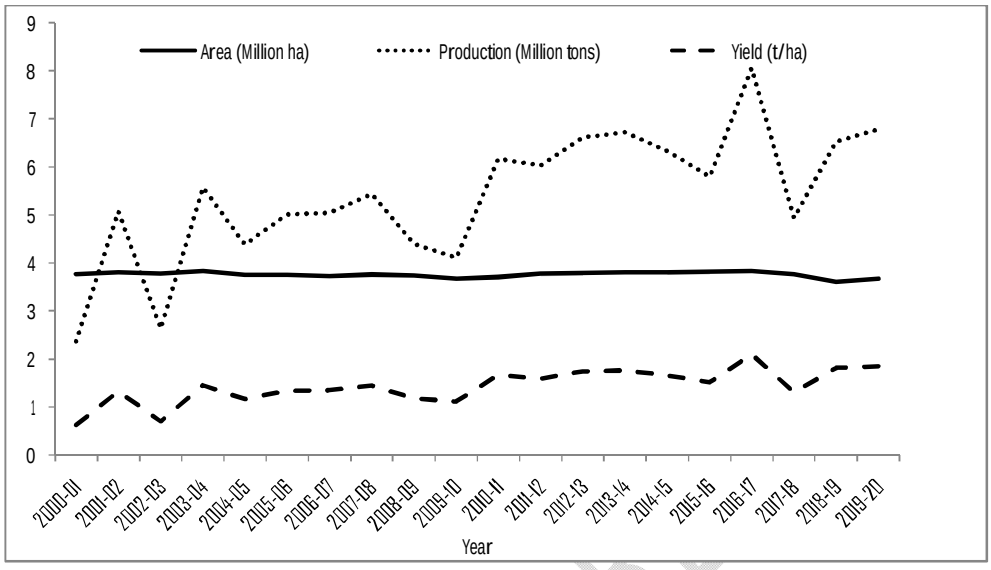

Figure 1. Area (million hectare), production (million tons) and yield (t/ha) of rice in Chhattisgarh state during 2000-01 to 2019-20

3.1 Compound Annual Growth Rate

The district wise growth rate of area, production and yield of rice in Chhattisgarh state has been presented in Table 1. It is revealed from the table that for all the three components area, production and yield; the growth rate ranges from -3.34 to 9.05across the districts for the studied three periods. The growth rate of area, production and yield ranges from -3-34 to 2.17, -3.08 to 9.05 and -3.16 to 8.17 respectively during the studied period.

During period I (2000-01 to 2009-10), the highest growth rate for area (2.16) was recorded in Dhamtari district and highest growth rate for production (9.05) and yield (8.17) was observed in Raipur district. Whereas, the lowest growth rate for area (-1.62) was recorded in Dantewada district and lowest growth rate for production (-3.08) and yield (-2.89) was found in Sarguja district. During this period I, the growth rate for area, production and yield was positive for most of the districts.

During period II (2010-1 to 2019-20), highest growth rate for area (2.17), production (4.51) and yield (4.72) was recorded in Kabirdham, Sarguja and Raigarh districts respectively. The lowest growth rate for area (-3.34) was found in Bilaspur district while lowest growth rate for production (-2.96) and yield (-3.16) was recorded in Jashpur district. In period II also most of the districts have positive growth rate for area, production and yield.

During the overall period III (2000-01 to 2019-20), highest growth rate for area (1.60), production (5.17) and yield (4.95) was recorded in Kabirdham, Durg and Janjgir-Champa districts respectively. The lowest growth rate for area (-2.16) and production (0.42) was observed in Bilaspur district while lowest growth rate for yield (1.22) was recorded in Rajnandgaon district. In almost all the periods, the lowest and highest

growth rate was observed in different districts. In this period, the growth rate for production and yield was positive for all the districts. The similar trend was observed in Punjab [5], Telangana [6] and West Bengal [9].

Table 1. District wise growth rate of area, production and yield of rice in Chhattisgarh state for various periods

Districts	Area			Production			Yield		
	P-I	P-II	P-III	P-I	P-II	P-III	P-I	P-II	P-III
Raipur	0.81	0.24	0.61	9.05	3.96	4.23	8.17	3.71	3.60
Mahasamund	1.03	0.98	1.26	8.31	1.07	4.74	7.20	0.09	3.44
Dhamtari	2.16	0.75	1.50	5.56	3.17	4.82	3.33	2.40	3.27
Durg	1.45	0.94	1.22	8.22	3.19	5.17	6.67	2.23	3.90
Rajnandgaon	0.87	1.30	1.35	-1.14	1.76	2.58	-1.99	0.46	1.22
Kabirdham - Kawardha	0.81	2.17	1.60	6.57	-0.05	3.64	5.71	-2.18	2.01
Bilaspur	0.23	-3.34	-2.16	2.21	-1.99	0.42	1.98	1.40	2.63
Janjgir - Chapma	0.69	-0.59	0.21	6.37	1.38	5.17	5.64	1.98	4.95
Korba	-0.09	-0.02	0.25	-0.89	1.35	1.64	-0.79	1.36	1.38
Raigarh	-1.27	-0.29	-0.40	4.60	4.41	3.25	5.95	4.72	3.66
Sarguja	-0.20	0.22	0.03	-3.08	4.51	1.41	-2.89	4.28	1.38
Jashpur	0.18	0.20	0.44	1.96	-2.96	1.71	1.78	-3.16	1.27
Koriya	-0.54	-0.17	-0.12	-0.80	1.48	2.45	-0.26	1.65	2.57
Dantewara	-1.62	1.64	-0.24	0.64	3.53	2.42	2.30	1.86	2.66
Kanker	1.42	0.95	1.16	5.30	0.38	3.82	3.82	-0.56	2.63
Bastar	0.25	-0.22	0.02	4.05	0.66	2.16	3.80	0.88	2.14
State	-0.10	0.04	0.00	4.01	2.02	3.32	4.12	1.98	3.32

P-I: Period I (2000-01 to 2009-10); P-II: Period II (2010-11 to 2019-20); P-III: Period III (2000-01 to 2019-20)

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3.2 Cuddy-Della Valle Instability Index

The level of instability cannot be detected by focusing only on growth rates. Growth rate will simply explain the rate of growth over time, whereas instability will determine whether the growth performance for the variable under study was stable or unstable over time. In this study, the level of instability in the area, production and yield of rice was determined by using Cuddy-Della Valle Index.

The Cuddy-Della Valle Index for area, production and yield of rice in Chhattisgarh state has beenpresented in Table 2. During period I (2000-01 to 2009-10), highest instability for area (9.37) was observed in Raigarhdistrict while highest instability for production (41.73) and yield (44.48) was recorded in Mahasamunsdistrict. Similarly, lowest instability for area (0.27) was recorded in Bastar district whereas lowest instability for production (11.40) and yield (13.67) was observed in Janjgir-Champa district. Same district recorded highest and lowest instability for production and yield.

During period II (2009-10 to 2019-20), highest instability for area (13.62) was recorded in Bilaspur district whereas highest instability for production (30.06) and yield (29.74) was found in Kanker district.The lowest instability for area (0.54), production (11.39) and yield (10.75) wasobserved in Korba, Janjgir-

Champa and Kabirdham-Kawardha districts respectively. In this period, same district recorded highest instability for production and yield.

Table 2. District wise instability of area, production and yield of rice in Chhattisgarh state for various periods

District	Area			Production			Yield		
	P-I	P-II	P-III	P-I	P-II	P-III	P-I	P-II	P-III
Raipur	3.09	1.83	2.65	29.30	21.20	24.35	31.43	20.65	25.22
Mahasamund	3.47	1.52	2.44	41.73	13.38	27.08	44.48	13.34	29.67
Dhamtari	7.56	9.58	8.84	22.05	25.88	25.19	17.47	19.64	18.61
Durg	6.88	2.58	4.77	39.20	22.61	28.11	42.19	20.40	29.02
Rajnandgaon	7.93	4.73	6.07	24.95	28.09	29.72	24.69	25.08	27.60
Kabirdham - Kawardha	8.75	5.80	7.67	28.14	14.68	21.91	33.48	10.75	26.03
Bilaspur	6.87	13.62	11.35	24.20	24.88	24.11	23.78	23.41	23.82
Janjgir - Chapma	6.11	4.00	5.27	11.40	11.39	15.57	13.67	11.11	14.86
Korba	6.74	0.54	4.51	22.48	19.75	21.40	22.56	19.97	21.26
Raigarh	9.37	2.95	7.03	20.74	21.10	20.50	25.95	19.44	21.34
Sarguja	5.03	0.89	3.51	18.99	14.85	20.77	18.50	15.12	20.48
Jashpur	6.13	0.61	4.05	21.28	15.92	23.55	24.23	15.82	24.07
Koriya	7.25	4.15	5.69	24.81	29.04	28.75	26.64	26.65	27.52
Dantewara	4.48	1.14	6.42	35.87	27.57	30.98	34.12	27.33	30.20
Kanker	5.59	1.61	3.73	20.30	30.06	28.90	20.73	29.74	28.48
Bastar	0.27	1.58	1.23	28.58	24.75	25.31	28.69	24.30	25.05
State	0.80	1.92	1.56	24.43	13.21	18.09	23.73	12.97	17.47

P-I: Period I (2000-01 to 2009-10); P-II: Period II (2010-11 to 2019-20); P-III: Period III (2000-01 to 2019-20)

During the overall period III (2000-01 to 2019-20), highest instability for area (11.35) was recorded in Bilaspur district while highest instability for production (30.98) and yield (30.20) was observed inDantewaradistrict. In the same way lowest instability for area (1.23) was observed in Bastar district; and lowest instability for production (15.57) and yield (14.86) was found in Janjgir-Champa district. Like, period I, in this period III also same district recorded highest and lowest instability for production and yield.

The highest and lowest instability for state was found in production (24.43) and area (0.80) respectively during period I. Same districts recorded highest instability for production and yield in all the three periods and Bilaspur district recorded highest instability for area during period II and III. Lowest stability forproductionwas recorded by Janjgir-Champa district during all the districts while same district recorded lowest instability for yield during period I and III.

3.3 Classification of Instability Index

All districts of Chhattisgarhstate have been classified based on the criteria proposed by Jambhulkar et al. [10-11] as very low instability, low instability, medium instability, high instability and very high instability

based on the instability value of the area, production and yield of rice. Numbers of districts fall under each class have been presented in Figure 2. None of the districts have been classified as very high instability for area, production and yield.

For area, all the districts fall under very low instability and low instability in all the periods. Similar result was found in Jambhulkar et al. [8-9]. In period I, 75% districts classified as low instability; under period II, more than 81% districts fall under very low instability; while in overall period III, 50% districts fall under both classes very low and low instability.For production, none of the districts showed very low instability and very high instability in all the periods. This is in line with Jambhulkar et al [8]. More than 68% districts classified as medium instability in all the periods.For yield also none of the districts were grouped as very low instability and very high instability. Jambhulkar et al. [7] observed none of the districts were classified as very high instability. Here, More than 81% districts were classified as medium instability in all the periods. In period II, maximum numbers of districts fall under medium instability class followed by low instability for production and yield.

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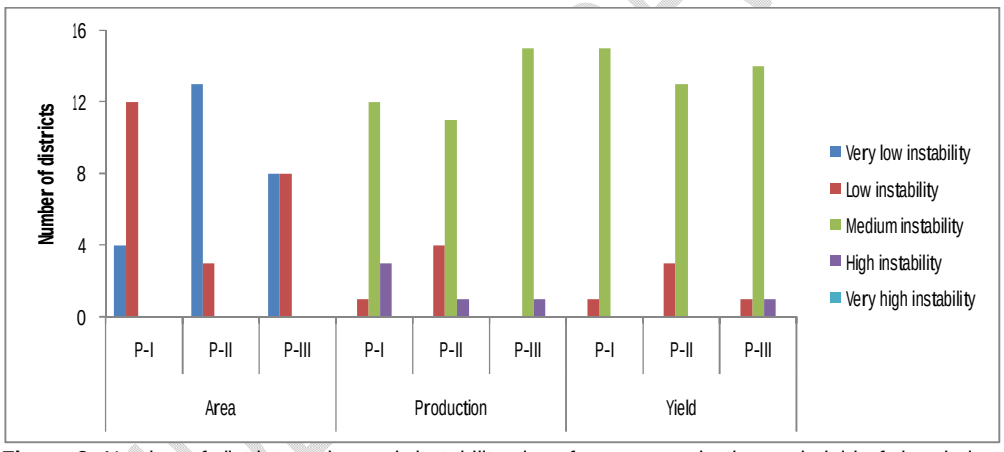

Figure 2. Number of districts under each instability class for area, production and yield of rice during three periods in Chhattisgarh state

P-I: Period I (2000-01 to 2009-10); P-II: Period II (2010-11 to 2019-20); P-III: Period III (2000-01 to 2019-20)

4. CONCLUSION

The study revealed that, for the state as a whole growth rate was positive in all periods for area, production and yield except it was negative for area in period I. The growth rate for production ranges from 2.02 to 4.01 and for yield ranges from 1.98 to 4.12. The highest growth rate was recorded in period I for yield. The instability for the state as a whole was ~~varies~~ from 0.80 in for area to 24.43 for production in period I. The instability was classified as very low instability for area, while it classified as low instability in period II and medium instability in period I and III for production and yield respectively.None of the

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districts show medium, high and very high instability for area, whereas none of the districts classified as very low and very high instability for production and yield in all the periods. For production and yield most of the districts classified as medium instability.This study may be useful for planners of Chhattisgarh state for implement the plan for the state at district level based on the results presented in the study.

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