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**Akash Tiwari**
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

**Dr. VK Choudhary**
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

**Dr. Ravi Shrey**
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

# Analysis on growth rate and decomposition analysis of major cereals grown in kharif season in northern hills of Chhattisgarh

## Akash Tiwari, Dr. VK Choudhary and Dr. Ravi Shrey

**Abstract**
In the present investigation, an attempt was made to study the decomposition and acreage response of various crops raised in Kharif and Rabi season in Norther hills of Chhattisgarh. The study was based on time series secondary data on the area, production and productivity, which were obtained from various Government publications. Decomposition model was used in acreage response analysis based on time series data. The study period was from 2001-02 to 2019-20 and it had divided into two periods. The decomposition analysis suggested that there was positive effect of area and interaction of area and yield except in Balrampur district for paddy while in case of Maize only Surajpur district produced negative interaction effect between area and yield of Northern hills, including Chhattisgarh. The study revealed that the compound growth rate for area and production under Paddy and Maize was recorded high during study in all the districts except Jashpur, Koria and Surajpur in terms of area of maize and for paddy Surajpur, Balrampur and Sarguja shown significant decline in area and production in northern hills of Chhattisgarh.

**Keywords:** Compound growth rate, decomposition, paddy and maize

## 1. Introduction
Growth of any variable indicates its past performance. The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period of time, it clearly indicates the performance of the variable under consideration. Climatic and soil conditions of Northern hills of Chhattisgarh permit the farmers to grow number of crop groups like cereals, pulses and oilseed crops. An attempt is made to analyse the direction of growth in area, production and productivity of all the major cereal crops grown in kharif season *viz.* Paddy and Maize from the year 2001 to 2020.

Rice (*Oryza sativa*) provides about 20% of the world's average calorie intake and accounts for 11% of the world's agricultural land. In 2017, world rice production was approximately 984 million tons (FAOSTAT 2019).

The theme "Rice is life" shows the importance of rice as an essential food and source of remuneration, especially in many non-industrial countries (Thanh and Singh 2006). Rice accounts for about 44% of the country's total food utilization and 23% of India's total planting area. In India and the world, the production of rice has a huge impact on food and nutrition security (Mishra *et al.*, 2014) [12].

Globally, Maize is known as queen of cereals because of its highest genetic yield potential among the cereals. Every part of the maize plant has economic value (the grain, leaves, stalk, tassel, and cob) and all are used to produce a large variety of food and non-food products. It is the most versatile crop and is grown in more than 166 countries across the globe, including tropical, subtropical and temperate regions, from sea level to 3000 m above mean sea level. It is cultivated in nearly 201 m ha with a production of 1162 m tonnes and productivity of 5754.7 kg/ha all over the world, having wider diversity of soil, climate, biodiversity and management practices (FAOSTAT 2020). India produced 31.51 million tonnes in an area of 9.9 million hectares in 2020-21, whereas in kharif 2021-22, maize production was 21.24 million tonnes (1st advance estimates) in an area of 8.15 million hectares (agricoop.nic).

**Corresponding Author:**
**Akash Tiwari**
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

## 1.1 Objectives
1. To estimate growth in area, production and productivity of major cereal grown in Northern hills of Chhattisgarh.
2. To analyze the decomposition of major cereal grown in Northern hills of Chhattisgarh.

## 2. Review of Literature
Malathi *et al.* studied the growth rate of area, production and yield and to measure the contribution of different components to the growth rate of millets in India from 1950-51 to 2011-12. The production of total millets registered significant growth during overall study period due to increase in yield. Increase in production of sorghum, pearl millet, finger millet and total millets were contributed by their yields, whereas area and its interaction with yield have adversely affected the production. Decline in production of small millets was due to area effect and interaction effect. The main source of growth in production of millets has been the growth in yield per hectare during the period from 1950-51 to 2011-12. Narmadha and Kandeepan study on Performance of Major Millet Crops in Tamil Nadu This study analyzed the growth rates, instability, and decomposition analysis of area, production, and productivity of major millets during the period from 1970 to 2015. The compound growth rate results showed that the growth rate in area and production for most of the millet crops, with the exception of maize, showed a negative growth rate. The instability indices revealed that the instability rate was high. The differentiation occurred in millet production due to the area for most of the millet crops, and area and productivity for some of the millet crops. Decomposition analysis showed that change in production occurred in millet production due to the area for most of the millet crops. N. Narmadha (2022) to assess the expansion of area under major crops over time, the compound growth rate was calculated (2001-2020). In cropping pattern, direction of changes was investigated using Markov chain analysis and for each year, crop diversification index was calculated. The results indicated that land classified as land put to non-agricultural uses and fallow land recorded positive expansion in area. The area under paddy, bajra, sugarcane, groundnut, and gingelly are growing at a negative rate, but maize, pulses, fruits, vegetables, coconut, and cotton are growing at a positive rate. It can be stated that net sown area in Tamil Nadu is declining, with shift in food crops being hurt worse than non-food crops. Based on Crop Diversification Index score, crop intensification has increased in the state over time, helping to reduce failure of crop and income loss while also creating jobs for rural people. Kiran *et al.* (2018) studied the Growth and instability of pulses on area, production and yield. The study is based on time-series data for 60 years (1950-51 to 2009-10) of pulses in India. Exponential growth rate, instability index and Hazel's decomposition analysis was used and it was found that the growth rate of area under pulses during the study period was non-significant, while production growth rate was just 0.59. The variation around the trend (instability index = 10.56) and the variation around mean (CV = 14.45%) was more in case of production. Increase in mean yield accounted for 99 percent of the increase in production. Variance in production of pulses was mainly due to residual factors.

## 3. Methodology
This study was based on the secondary data. The data were collected from various government publications like, Ministry of Commerce & Industry"- Government of India, Agri Indiastat, DAC & FW, Directorate of Economics & Statistics, FAO (Food and Agricultural Organization) Stat.

## 3.1 Growth Rates Analysis
Growth of any variable indicates its past performance. The analysis of growth is usually used in economic studies to find out the movements of a particular variable over a period of time. It clearly indicates the performance of the variable under consideration and hence it can be very well used for making policy decisions. Annual compound growth rate in area, production and productivity of major selected crops was done in the study area and for Chhattisgarh state by

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

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

Where,
Y= Area/ production /productivity of major crops
$\alpha$= Constant
$\beta$= Regression coefficient
t= time in year
Compound growth rate (%) = (Antilog $\beta$-1)100.

Where,
b = regression coefficient
Coefficient of variation = standard variation ÷ mean × 100

## 3.2 Decomposition of total agricultural output growth
The contribution of area and productivity or the interaction of area and yield of the production was estimate by using the decomposition profounded by Dr. Minhas 1964, which is used to estimate the contribution of area and yield to production changes (positive/negative).

**Area Effect:** Shows percentage share of area in total production

$$AE = \frac{(A_n - A_0)Y_0}{P_n - P_0} \times 100$$

**Yield Effect:** Shows percentage share of average yield in total production

$$AE = \frac{(Y_n - Y_0)A_0}{P_n - P_0} \times 100$$

**Interaction Effect:** Shows percentage share of area and yield (simultaneous variation) interaction towards total production.

$$IE = \frac{(A_n - A_0)Y_0(Y_n - Y_0)A_0}{P_n - P_0} \times 100$$

Where,
$A_0$ = Triennium average of area in base year
$P_0$ = Triennium average of production in base year
$A_n$ = Triennium average of area in current year
$P_n$ = Triennium average of production in current year
$Y_n$ = $P_n / A_n$
$Y_0$ = $P_0 / A_0$

## 4. Results and Discussion
### 4.1 Compound annual growth rate (CAGR) of area, production and productivity of paddy
The compound growth rate of area, production and productivity of Nutri cereals were calculated and shown in the Table 1.

**4.1.1 Compound annual growth rate (CAGR) of paddy area**
From the table, it is seen that during the study period, the highest significant growth in the area of paddy has been seen in Balrampur district with 1.88 percent followed by Surajpur with 0.802 percent and least positive growth in production has been observed in Jashpur district with 0.118 percent and a significant decline was recorded in Sarguja district with (-7.123) percent per annum because after year 2011 two districts were separated from this district *i.e.*, Surajpur and Balrampur.
State having positive growth rate of 0.0036 percent per annum.

**4.1.2 Compound annual growth rate (CAGR) of paddy production**
From the pursual of table 4.1 it can be seen that during the study period, the highest significant growth in Paddy production is recorded in Koria district with 2.42 percent followed by and a significant decline was recorded in Sarguja district with (-4.605)

percent per annum in production because after year 2011 two districts were separated from this district *i.e.*, Surajpur and Balrampur.
In case of Northern hills there was a significant positive growth recorded with 2.312 percent and State also registered significant growth in production of 0.026 percent per annum.

**4.1.3 Compound annual growth rate (CAGR) of paddy productivity**
The table 4.1. indicates that districts Koria registered significant increase by 3.265 percent followed by Sarguja with 2.909 percent per annum even though it divided into two districts *i.e.*, Surajpur and Balrampur. whereas none other districts have shown significant growth in paddy productivity.
Northern hills there was a significant positive growth recorded with 2.272 percent and State registered significant growth rate in productivity of 0.023 percent per annum.

**Table 1:** Compound annual growth rate (CAGR) of area, production and productivity of Paddy in different districts of Chhattisgarh during 2001 to 2020

| Districts | Initial year (2001-02) | End year (2019-20) | CAGR (%) |
|---|---|---|---|
| **Area (ha)** | | | |
| Jashpur | 178.79 | 185.05 | 0.118%* |
| Koria | 70.15 | 73.95 | 0.047% NS |
| Surajpur | 106.93 | 112.72 | 0.802%** |
| Balrampur | 78.49 | 91.33 | 1.88%* |
| Sarguja | 311.94 | 113 | -7.123%* |
| Norther hills | 561.22 | 576.05 | 0.038%NS |
| Chhattisgarh State | 3758.63 | 4042.04 | 0.0036%*** |
| **Production (Mt)** | | | |
| Jashpur | 221.23 | 277.31 | 1.149%NS |
| Koria | 102.21 | 165.67 | 2.42%*** |
| Surajpur | 151.90 | 185.73 | 0.398% NS |
| Balrampur | 144.38 | 172.90 | 1.416% NS |
| Sarguja | 408 | 183.79 | -4.605%*** |
| Norther hills | 731.77 | 985.40 | 2.312* |
| Chhattisgarh State | 5004.38 | 8525.03 | 0.026%** |
| **Productivity (kg/ha)** | | | |
| Jashpur | 1235 | 1499 | 1.23% NS |
| Koria | 1457 | 2240 | 3.265%* |
| Surajpur | 1487 | 1648 | -1.0806% NS |
| Balrampur | 1855 | 1893.00 | -0.358% NS |
| Sarguja | 1309 | 1626.45 | 2.909%* |
| Norther hills | 1304 | 1711 | 2.272* |
| Chhattisgarh State | 1331.00 | 2109.00 | 0.023%*** |

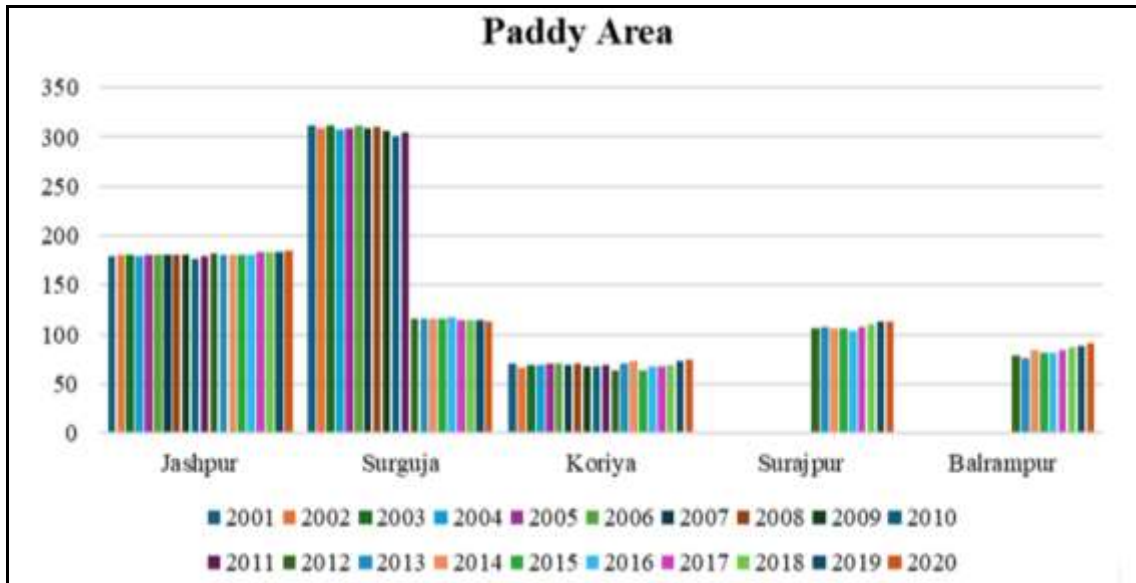*, **, *** indicate significant at 1 percent, 5 percent and 10 percent probability levels, respectively

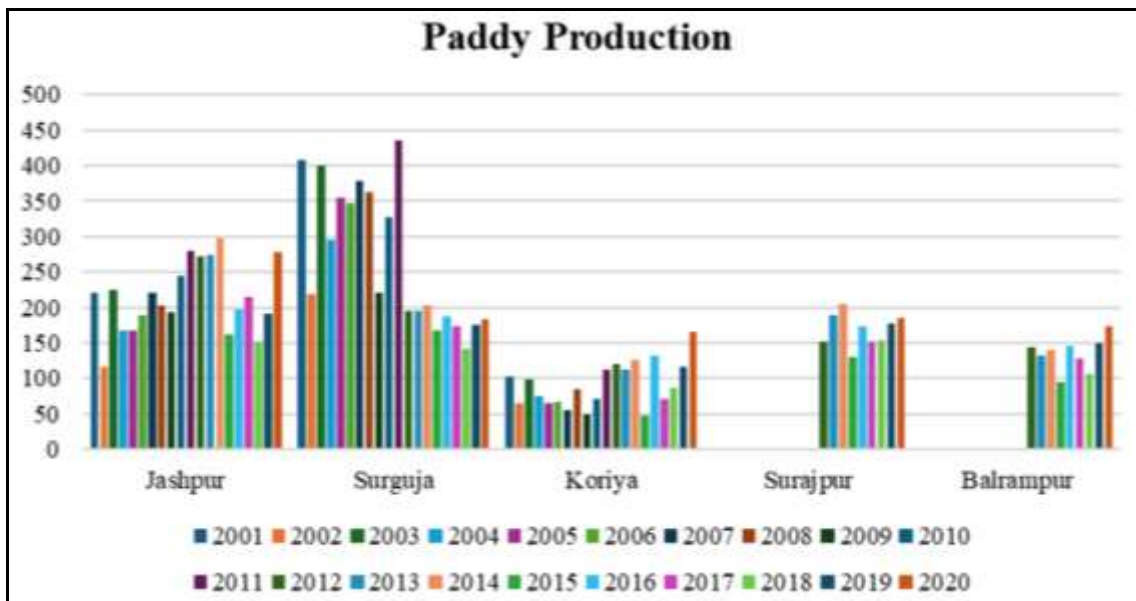**Fig 1:** Trend in area of Paddy in Northern hills of Chhattisgarh



**Fig 2:** Trend in production of Paddy in Northern hills of Chhattisgarh
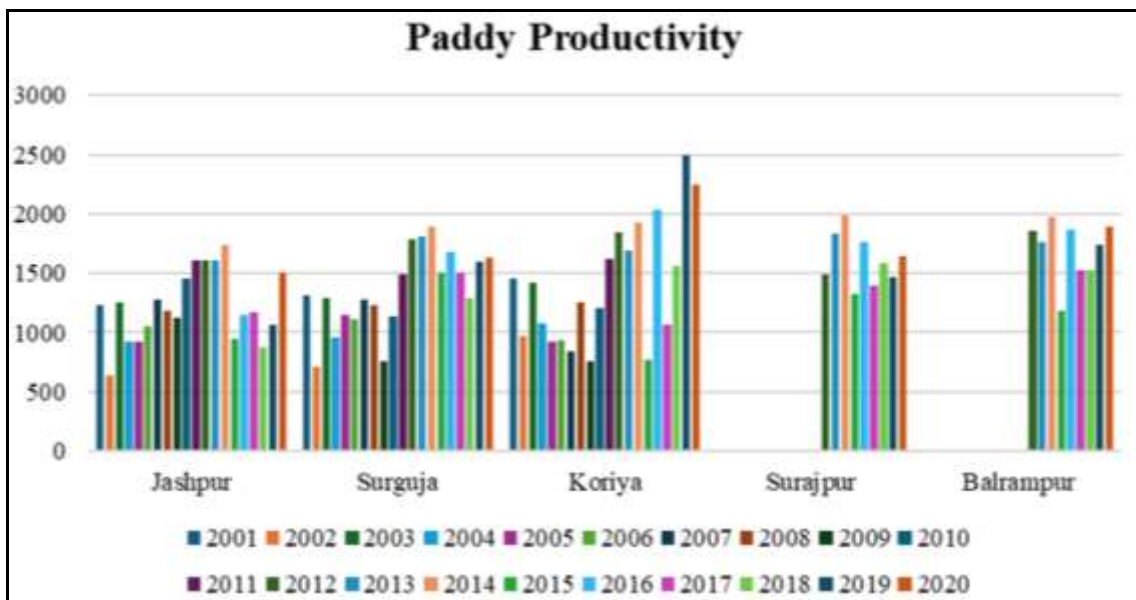


**Fig 3:** Trend in productivity of Paddy in Northern hills of Chhattisgarh

## 4.2 Compound annual growth rate (CAGR) of area, production and productivity of paddy

### 4.2.1 Compound annual growth rate (CAGR) of Maize area

A perusal of table 4.3 indicate that Balrampur and district registered significant positive growth rate of 8.559 percent followed by Koria with 0.014 percent per annum. whereas a significant decline was recorded in Jashpur and Sarguja in area at the rate of (-0.958), and (-9.232) percent per annum respectively.

In case of Northern hills there was a significant positive growth recorded with 0.947 percent and State registered significant growth in area of Maize at the rate of 0.0036 percent per annum.

### 4.2.2 Compound annual growth rate (CAGR) of Maize production

From the table, it is seen that during the study period, the highest significant growth in Maize production to the tune of 17.964

percent was recorded in Balrampur district, followed by Surajpur, Jashpur and Koria with 5.098, 3.56 and 3.23 percent per annum. Only Sarguja district shown insignificant growth in terms of production.

Northern hills there was a significant positive growth recorded with 9.034 percent and State shows significant decline in production of Maize at the rate of 0.026 percent per annum.

### 4.2.3 Compound annual growth rate (CAGR) of Maize productivity

The table 4.3 indicates that all the registered district of the study area has shown positive growth rate in productivity of Maize per annum.

Northern hills there was a significant positive growth recorded with 10.067 percent and State shows significant increase in productivity of Maize at the rate of 0.023 percent per annum.

**Table 2:** Compound annual growth rate (CAGR) of area, production and productivity of Maize in different districts of Chhattisgarh during 2001-2020

| Districts | Initial year | End year | CAGR (%) |
|---|---|---|---|
| Area (ha) | | | |
| Jashpur (2001 – 20) | 6.55 | 5.78 | -0.958%* |
| Koria (2001 – 20) | 8.55 | 5.31 | 0.014%* |
| Surajpur (2012 – 20) | 11.67 | 12.89 | -0.397%NS |
| Balrampur (2012– 20) | 18.28 | 38.05 | 8.559%* |
| Sarguja (2001- 20) | 37.317 | 14.24 | -9.232%* |
| Northern hills (2001 – 20) | 52.18 | 76.27 | 0.947% |
| Chhattisgarh State (2001 – 20) | 3758.63 | 4042.04 | 0.0036%*** |
| Production (Mt) | | | |
| Jashpur (2001 – 20) | 5.98 | 16.92 | 3.56%* |
| Koria (2001 – 20) | 7.09 | 11.26 | 3.23%* |
| Surajpur (2012 – 20) | 20.23 | 27.16 | 5.098** |
| Balrampur (2012 – 20) | 37.69 | 135.51 | 17.964%* |
| Sarguja (2001– 20) | 7.09 | 45.95 | 1.457% NS |
| Northern hills (2001 – 20) | 20.16 | 236.81 | 10.067%* |
| Chhattisgarh State (2001 – 20) | 5004.38 | 8525.03 | 0.026%** |
| Productivity (kg/ha) | | | |
| Jashpur (2001 – 20) | 912 | 2928 | 4.563%* |
| Koria (2001 – 20) | 829 | 2121 | 4.65%* |
| Surajpur (2012 – 20) | 1768 | 2107 | 5.516%** |
| Balrampur (2012 – 20) | 2062 | 3562 | 8.664%* |
| Sarguja (2001 – 20) | 547 | 3227.01 | 6.157%* |
| Northern hill (2001 – 20) | 386.39 | 3104.93 | 9.034%* |
| Chhattisgarh State (2001 – 20) | 1331.00 | 2109.00 | 0.023%*** |

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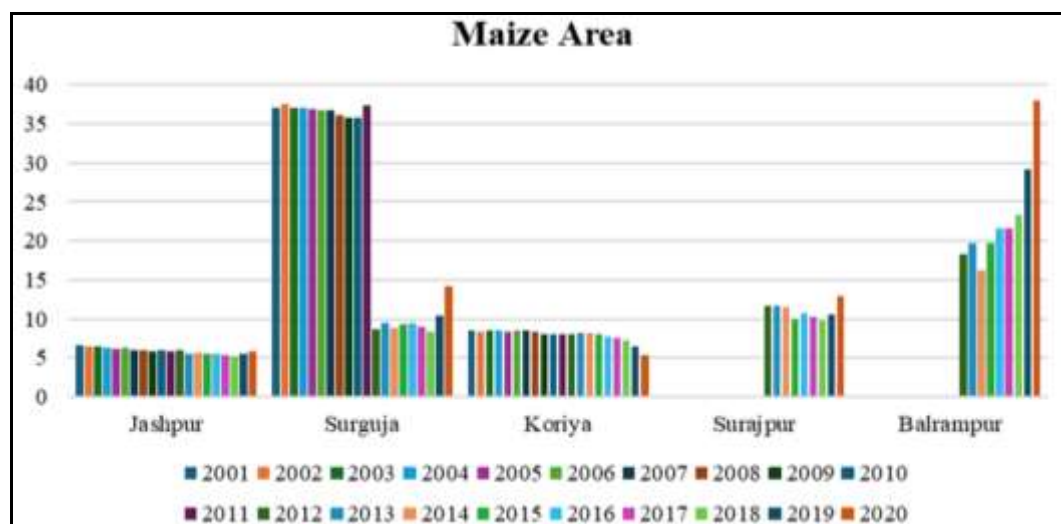


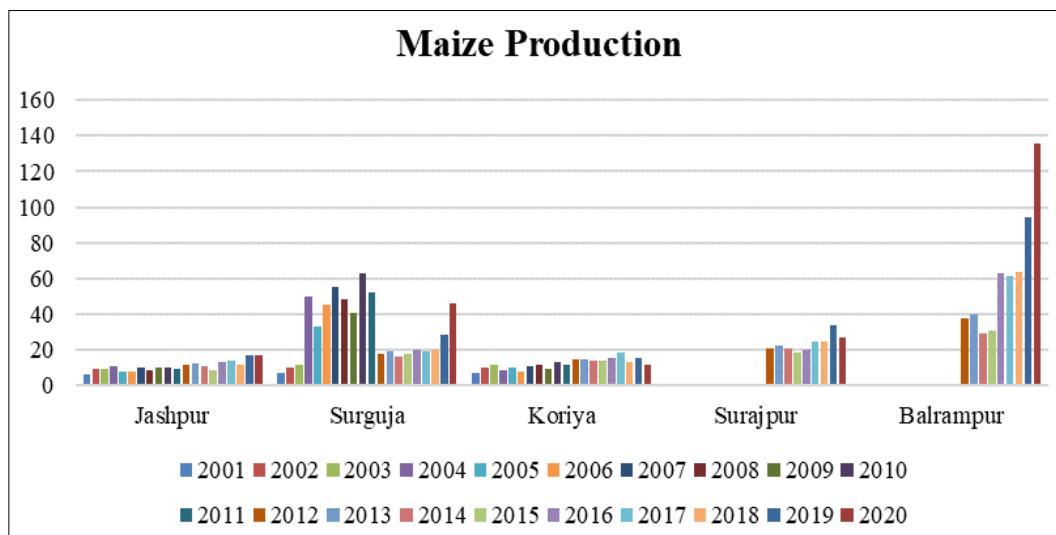**Fig 4:** Trend in area of Maize in Northern hills of Chhattisgarh

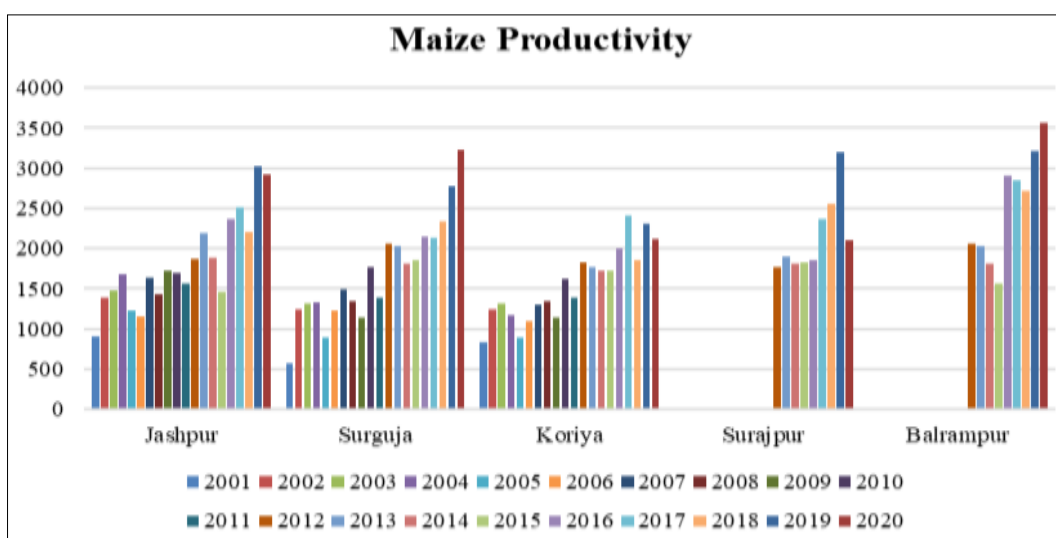**Fig 5:** Trend in production of Maize in Northern hills of Chhattisgarh



**Fig 6:** Trend in productivity of Maize in Northern hills of Chhattisgarh

### 4.3 Decomposition analysis
Jamal estimated the effect of area and yield on production using decomposition analysis. The contribution of area, yield and interaction of the two in total production, decomposition analysis as given below.

**Table 3:** Change in production of Paddy and Maize in Northern hills of Chhattisgarh (in percent)

| Paddy | | | |
|---|---|---|---|
| Particular | AE | Ye | IE |
| Jashpur | 13.83 | 80.22 | 5.95 |
| Koria | 3.84 | 71.89 | 24.26 |
| Surajpur | 200.33 | -110.88 | 10.55 |
| Balrampur | -239.08 | 366.21 | -27.13 |
| Sarguja | 17.54 | 62.31 | 20.14 |
| Maize | | | |
| Particular | AE | Ye | IE |
| Jashpur | 0.23 | 45.86 | 53.90 |
| Koria | 0.40 | 53.94 | 45.65 |
| Surajpur | 121.35 | -15.06 | -6.29 |
| Balrampur | 36.77 | 38.56 | 24.65 |
| Sarguja | 1.28 | 8.87 | 89.84 |

The yield effect and area interaction effect for paddy has found to be positive except in Balrampur district similarly for Maize

that there was positive effect of area and interaction of area and yield except Surajpur district of Chhattisgarh. So that it can be concluded that the significant increase in the production of maize was due to adoption of technology in cultivation of Paddy and Maize.

### 5. Conclusion
Positive significant growth for area was observed in Jashpur, Surajpur, Balrampur, while Sarguja district has shown significant negative growth during the study period while northern hills has shown non-significant growth for area. Production & productivity has significant growth rate in Koria, Sarguja, northern hill and Chhattisgarh state can be observed for paddy.

Maize, all the selected area for study area has significant growth rate for area except Surajpur while Sarguja has only recorded negative growth for production. While productivity has been observed to positive for all.

The area and interaction effect were found to be positive for all the district except for Balrampur district for paddy while for the maize crop the interaction effect was found negative only in Surajpur district. Highest yield effect was observed in Balrampur for paddy while for maize same was observed in Koria

## 6. References

1. Acharya SP, Basavaraja H, Kunnal LB, Mahajanashetti SB, Bhat ARS. Growth in area, production and productivity of major crops in Karnataka. Karnataka Journal of Agricultural Science. 2012;25(4):431-436.
2. Anonymous. Assistant Director of Agriculture, Govt. of Chhattisgarh; c2020.
3. Anonymous. District Statistical Book of Chhattisgarh, Govt. of Chhattisgarh; c2021.
4. Anupama J, Sahu RM, Yogita K. Decomposition analysis of major cereal crops in different agroclimatic regions of Chhattisgarh. International Journal of Chemical Studies. 2019;7(6):2198-2200.
5. Bajwa. 2000. Forecasting of heat Production in Pakistan using RIMA model. Journal of Agriculture & Biology. 2000;2(4):352-353.
6. Singh A, Srivastava RSL; c2003.
7. Deepak P. A Comparison of forecasting methods: Fundamentals, Polling, Prediction Markets, and Experts. Journal of Prediction Markets. 2015;23(2):1-31.
8. Devi YL, Arivelarasan T, Jenny K. 2017. Pulses Production in India: Trend and Decomposition Analysis. Economic Affairs. 2017;62(3):435-438.
9. Divya A, Hulas P. 2018. An Economic Analysis of Growth Performance of Major food Grains in Chhattisgarh. Trends in Biosciences. 2018;11(34):0974-8431.
10. Kumar H, Devraj. Growth rates of field pea in India - A Decomposition Analysis. Agricultural Situation in India. 2010;67:127-129.
11. Mahesh P, Deepa NR. Trend Analysis of Area, Production and Productivity of Rice in Kerala in the Context of Food Security. International Journal of Agricultural Research and Review. 2016;4(8):539-546.
12. Mishra VK. Impact of Globalization on the Area, Production and Yield of the Food grains in India. Third International Conference on Science, Technology and Management. 2016;74(6):36-43.
13. Neelam K, Mehta VP, Bhatia JK. 2020. Foodgrains Production in India: Trend and Decomposition Analysis. Economic Affairs. 2020;65(3):333-342.
14. Puneet D. 2019. Time series modelling for forecasting of food grain production and productivity of India. Journal of Pharmacognosy and Phytochemistry. 2019;8(3):476-482.
15. Ruchi. 2017. Food grains in India: Growth, instability and decomposition analysis. International Journal of Multidisciplinary Research and Development. 2017;4(6):304-308.
16. Sharma A. Trends in Area, Production and Productivity of Food Grain Crops: An Overview. Economic Affairs. 2013;58(1):1.
17. Jamal, Zaman. Decomposition of growth trend in agriculture: Another approach. Indian Journal of Agricultural Economics. 1992;47(4):644-652.
18. Malathi, *et al*. Growth pattern of millets in India. Indian Journal of Agricultural Research. 2016;50(4):382-386.
19. Narmadha, Kandeepan. Performance of Major Millet Crops in Tamil Nadu: An Economic analysis. Indian Journal of Economics and Research. 2017;6(5):351-360.
20. Anonymous. Pocket-Book on Agricultural Statistics. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, India; c2016. p. 26-32, 66-73.