

Trend and growth rate in area, production and productivity of papaya in the Chhattisgarh plain zone

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Abstract

Papaya (*Carica papaya*) is a significant horticultural fruit crop cultivated both in household kitchen gardens and commercially throughout India. Papaya holds great economic and nutritional importance. The present study was confined to the Chhattisgarh Plains agroclimatic zone of Chhattisgarh. There are 11 districts in the selected region namely Raipur, Bilaspur, Janjgir, Korba, Raigarh Mahasamund, Durg, Kanker, Dhamtari Kabirdham, and Rajnandgaon. these districts were chosen purposefully for the study. The Chhattisgarh plain zone showed positive trends in papaya cultivation. Area-wise, most districts recorded significant increases, with an annual rise of 457 ha and an SGR of 3.63%. In terms of production, districts like Raigarh, Janjgir, and Durg showed strong growth, with a significant annual increase of 15,614.55 metric tonnes and a 4.93% SGR. Productivity also improved in most districts, with a yearly rise of 343.04 kg/ha and an SGR of 1.37%, despite declines in a few areas.

Keywords: Papaya, Chhattisgarh plains, trend, growth and area

1. Introduction

Papaya (*Carica papaya*) is a significant horticultural fruit crop cultivated both in household kitchen gardens and commercially throughout India. Papaya holds great economic and nutritional importance. Ripe fruits are consumed in various forms such as salads, juices, jellies, jams, and candies, while green and immature fruits are used as vegetables and in the preparation of tutti-frutti. It is a rich source of essential nutrients like proteins, carbohydrates, calcium, and antioxidants, and also has substantial medicinal value. India ranks first globally in papaya production, followed by Brazil and Mexico (FAOSTAT, 2020). As of 2020, papaya was cultivated on approximately 142 thousand hectares in India, producing around 6.01 million tonnes. The leading papaya-producing states include Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, and Chhattisgarh. Commonly cultivated varieties in India include Pusa Nanha, Pusa Giant, Pusa Majesty, Honey Dew, and Pusa Delicious.

Chhattisgarh, in particular, holds a significant position in India's papaya production. It is ranked third in terms of total fruit production and sixth in papaya production, contributing approximately 381.42 thousand metric tonnes, which is 6.36% of the national total (National Horticultural Board, 2020). Papaya cultivation is prevalent across most districts, including Bilaspur, Raipur, Durg, and Mahasamund. In the 2020–21 period, the Chhattisgarh Plains agroclimatic zone had 13.987 thousand hectares under papaya cultivation, resulting in a production volume of 377.383 thousand metric

tonnes (National Horticultural Board, 2020).

2. Materials and Methods

2.1 Selection of the Area

The state of Chhattisgarh comprises three agroclimatic zones namely Chhattisgarh Plain Northern Hills zone, Bastar Plateau, the present study was confined to the Chhattisgarh Plains agroclimatic zone of Chhattisgarh. There are 11 districts in the selected region namely Raipur, Bilaspur, Janjgir, Korba, Raigarh Mahasamund, Durg, Kanker, Dhamtari Kabirdham, and Rajnandgaon. these districts were chosen purposefully for the study.

2.2 Period of the Study

The analysis covered 12 years. This research considered data for the period 2009-10 to 2020-21. Analysis has been done to find out the Growth rate, Relative change, absolute change, yield effect, area effect, and interaction effect and policy related to papaya production for the whole period.

Period (2009-10 to 2020-21)

Base year (Triennium ending) - 2009-10 to 2011-12

Current year (Triennium ending)- 2018-19 to 2020-21

2.3 Nature and Source of Data

The study was conducted mainly in 11 districts of the Chhattisgarh plain zone of Chhattisgarh state. The state is divided into 3 agroclimatic zones namely the Chhattisgarh plains, the Baster plateau, and the northern hills zone,

including 28 Chhattisgarh districts out of the three agroclimatic zones, Chhattisgarh plain zone was selected purposely for the study. The data pertaining to the area, production and productivity of papaya was obtained from the official website of the Chhattisgarh Agricultural Development and Farmer Welfare and Biotechnology Department Chhattisgarh.

2.4 Analytical tools: The analytical tools used in this study are mentioned below

2.4.1 Trend

To analyze the growth rates of the Papaya crop in the Chhattisgarh state trend analysis was carried out using the linear trend method

Linear trend, $Y = a + bx$

Where,

Y= dependent variables (Area, production, productivity)

a= intercept

b= Regression co-efficient

x=Period

2.4.2 Simple Growth Rate (SGR)

$$\text{SGR (\%)} = \frac{b}{\bar{y}} \times 100$$

Where,

b= Regression co-efficient

\bar{Y} = Mean value of dependent variable

3. Results

3.1 Trend and growth rate in area, production and productivity of papaya in the Chhattisgarh Plain zone

This section has presented the outcome of the analysis of trends and percent growth rate of area, production and productivity of papaya crop in linear forms, using statistical tools such as linear equation and simple growth rate (SGR). The time series data has been fitted district by district to give an idea regarding the direction and rate of change in papaya area, production and productivity. Regression coefficient and SGR values are calculated and are presented in tabular form and explained under the following subhead:

3.1.1 Area

The trend coefficient and simple growth rate of the area of papaya in different districts of the Chhattisgarh plain zone of the state have been calculated, under the heading area:

Regarding Raigarh district, the value of the trend coefficient (20.84) was positive and significant at a 1% level of significance. The SGR value (6.60%) was also positive, which shows that the Papaya area has increased during the period of study. In the Bilaspur district, the value of the regression coefficient (44.84) was positive but non-significant and the SGR value (2.06%) was also positive, i.e., the area of papaya shows increasing trends. Kabirdham district has shown an increasing trend in the area of papaya, at the rate of 10.97 percent and the trend coefficient (25.76) value was positive and significant at 1% level of significance.

In the case of Janjgir district, papaya area has positive and highly significant (1%) regression coefficient value (12.50) and SGR value (1.71%) was found positive, i.e., area of the papaya shows increasing trends. Regarding Mahasamund district, the value of trend coefficient (75.50) was positive and significant at 5% level of significance. The SGR value (7.16%) was also positive, that has shown that Papaya area has increased during the period of study.

Rajnandgaon district has shown the increasing trend in area of papaya, at the rate of 5.84 percent and trend coefficient (17.73) value was positive and significant at 5% level of significance. In Durg district, value of regression coefficient (89.97) was positive and significant at 1% level of significance and the SGR value (4.76%) was also positive, i.e., area of papaya shows increasing trends. In case of Dhamtari district, papaya area has positive and highly significant (1%) regression coefficient value (23.41) and SGR (6.37%) value was found positive, i.e., area of papaya shows increasing trends. In Kanker district, value of regression coefficient (11.63) was positive and non-significant whereas, the SGR value (4.56%) was also positive, i.e., area of papaya shows increasing trends.

Linear regression coefficient value has shown the positive increasing trend of area under papaya for majority of the districts of the zone except Korba and Raipur, where area has shown the decreasing trend during the period of study. In case of Korba district, papaya area has negative and highly significant (1%) regression coefficient value (59.87) and SGR (18.69%) value was found negative, i.e., area of papaya shows decreasing trends. Similarly, the Raipur district has shown the decreasing trend in area of papaya, at the rate of 1.84 percent and trend coefficient (31.34) value was negative and non-significant. In total area of papaya has shown the positive and highly significant trend coefficient value (230.95), with the simple growth rate of 2.47 percent, in Chhattisgarh plain zone. thus, it could be concluded from the Table 1 that, the trend coefficient value (457) was positive and significant at 1% level, with the growth rate of 3.63 percent during the study period. This indicated that area of papaya has been increased by 457 ha in Chhattisgarh state per year.

3.1.2 Production

Trend coefficient and simple growth rate of production of papaya in different districts of the Chhattisgarh plain zone of the state have been calculated, under the heading production:

Regarding Raigarh district, the value of the trend coefficient (1056.99) was positive and significant at a 1% level of significance. The SGR value (10.49%) was also positive, which has shown that Papaya production has increased during the period of study. In the Bilaspur district, the value of the regression coefficient (1285.38) was positive but non-significant and the SGR value (2.57%) was also positive, i.e., the production of papaya shows increasing trends.

Kabirdham district has shown the increasing trend in production of papaya, at the rate of 8.44 percent and trend coefficient (259.44) value was positive and significant at 1% level of significance. In case of Janjgir district, papaya production has positive and highly significant (1%) regression coefficient value (657.62) and SGR value (4.28%) was found positive, i.e., production of papaya

shows increasing trends. Regarding Mahasamund district, the value of trend coefficient (2302.87) was positive and significant at 1% level of significance. The SGR value (10.79%) was also positive, that has shown that Papaya production has increased during the period of study. Rajnandgaon district has shown the increasing trend in production of papaya, at the rate of 7.20 percent and trend coefficient (424.41) value was positive and significant at 1% level of significance.

In Durg district, value of regression coefficient (3539.55) was positive and significant at 1% level of significance and the SGR value (4.70%) was also positive, i.e., production of papaya shows increasing trends. In case of Raipur district, papaya production has positive and moderately significant (5%) regression coefficient value (2083.99) and SGR (3.97%) value was found positive, i.e., production of papaya shows increasing trends. In Kanker district, value of regression coefficient (190.03) was positive and non-significant whereas, the SGR value (4.63%) was also positive, i.e., production of papaya shows increasing trends. Linear regression coefficient value has shown the positive increasing trend of production under papaya for majority of the districts of the zone except Korba and Dhamtari, where production has shown the decreasing trend during the period of study. In the case of the Korba district, papaya production has a negative and non-significant regression coefficient value (757.07) and SGR (8.86%) value was found negative, i.e., production of papaya shows decreasing trends. Similarly, the Dhamtari district has shown a decreasing trend in the production of papaya, at the rate of 2.27 percent and trend coefficient (93.31) value was negative and non-significant. In total, the production of papaya has shown a positive and highly significant trend coefficient value (10949.91), with a simple growth rate of 4.37 percent, in the Chhattisgarh plain zone.

Thus, it could be concluded from Table 1 that, the trend coefficient value (15614.55) was positive and significant at 1% level, with a growth rate of 4.93 percent during the study period. This indicated that production of papaya has been increased in Chhattisgarh state by 15614.55 metric tonnes per year.

3.1.3 Productivity

Trend coefficient and simple growth rate of productivity of papaya in different districts of the Chhattisgarh plain zone of the state has been calculated, under the heading productivity:

In case of Korba district, papaya productivity has positive and non-significant regression coefficient value (323.17) and SGR (1.56%) value was found negative, i.e., productivity of papaya shows increasing trends. Regarding Raigarh district, the value of trend coefficient (1510.89) was

positive and significant at 5% level of significance. The SGR value (4.90%) was also positive, that has shown that Papaya productivity has increased during the period of study. In Bilaspur district, value of regression coefficient (52.46) was positive and significant at 1%, and the SGR value (0.23%) was also positive, i.e., productivity of papaya shows increasing trends. In case of Janjgir district, papaya productivity has positive and highly significant (1%) regression coefficient value (557.75) and SGR value (2.67%) was found positive, i.e., productivity of papaya shows increasing trends.

Regarding Mahasamund district, the value of trend coefficient (754.38) was positive and significant at 5% level of significance. The SGR value (3.79%) was also positive, that has shown that Papaya productivity has increased during the period of study. Rajnandgaon district has shown the increasing trend in productivity of papaya, at the rate of 1.30 percent and trend coefficient (250.93) value was positive and significant at 1% level of significance. In case of Raipur district, papaya productivity has positive and highly significant (1%) regression coefficient value (2031.88) and SGR (6.42%) value was found positive, i.e., productivity of papaya shows increasing trends. In Kanker district, value of regression coefficient (8.70) was positive and non-significant whereas, the SGR value (0.05%) was also positive, i.e., productivity of papaya shows increasing trends.

Linear regression coefficient value has shown the positive increasing trend of productivity under papaya for majority of the districts of the zone except Kabirdham, Durg and Dhamtari, where productivity has shown the decreasing trend during the period of study. Kabirdham district has shown the decreasing trend in productivity of papaya, at the rate of 3.52 percent and trend coefficient (485.16) value was positive and significant at 1% level of significance. In Durg district, value of regression coefficient (30.21) was negative and significant at 5% level of significance and the SGR value (0.08%) was also negative, i.e., productivity of papaya shows increasing trends. Similarly, the Dhamtari district has shown the decreasing trend in productivity of papaya, at the rate of 9.02 percent and the trend coefficient (1098.11) value was negative and significant at the 1% level. In total, the productivity of papaya has shown a positive and highly significant trend coefficient value (545.38), with a simple growth rate of 2.05 percent, in the Chhattisgarh plain zone.

Thus, it could be concluded from the Table 1 that, the trend coefficient value (343.04) was positive and significant at a 1% level, with a growth rate of 1.37 percent during the study period. This indicated that the productivity of papaya has been increased in Chhattisgarh state by 343.04 kg/ha per year.

Table 1: Trend and growth rate of area, production and productivity of papaya crop in the Chhattisgarh Plain zone

District	Area (ha)			Production(mt)			Productivity(kg/ha)		
	trend	SE	SGR	trend	SE	SGR	trend	SE	SGR
1. Korba	-59.87**	16.88	-18.69	-757.07	414.33	-8.86	323.17	547.19	1.56
2. Raigarh	20.84**	2.07	6.60	1056.99**	108.50	10.49	1510.89*	479.54	4.90
3. Bilaspur	44.84	25.08	2.06	1285.38	1343.82	2.57	52.46**	496.26	0.23
4. Kabirdham	25.76**	2.25	10.97	259.44**	35.64	8.44	-485.16**	80.38	-3.52
5. Janjgir	12.50**	3.32	1.71	657.62**	76.85	4.28	557.75**	76.21	2.67
6. Mahasamund	75.50*	29.27	7.16	2302.87**	684.07	10.79	754.38*	316.56	3.79

7. Rajnandgaon	17.73*	6.13	5.84	424.41**	116.90	7.20	250.93**	52.43	1.30
8. Durg	89.97**	12.93	4.76	3539.55**	508.59	4.70	-30.21*	12.44	-0.08
9. Raipur	-31.34	27.09	-1.84	2083.99*	783.95	3.97	2031.88**	297.54	6.42
10. Dhamtari	23.41**	2.93	6.37	-93.31	63.85	-2.27	-1098.11**	242.70	-9.02
11. Kanker	11.63	8.95	4.56	190.03	143.73	4.63	8.70	4.07	0.05
Chhattisgarh plain zone	230.95**	70.43	2.47	10949.91**	2349.52	4.37	545.38**	128.63	2.05
Chhattisgarh state	457.00**	16.88	3.63	15614.55**	414.33	4.93	343.04**	92.78	1.37

** and * represent 1% and 5% level of significance respectively.

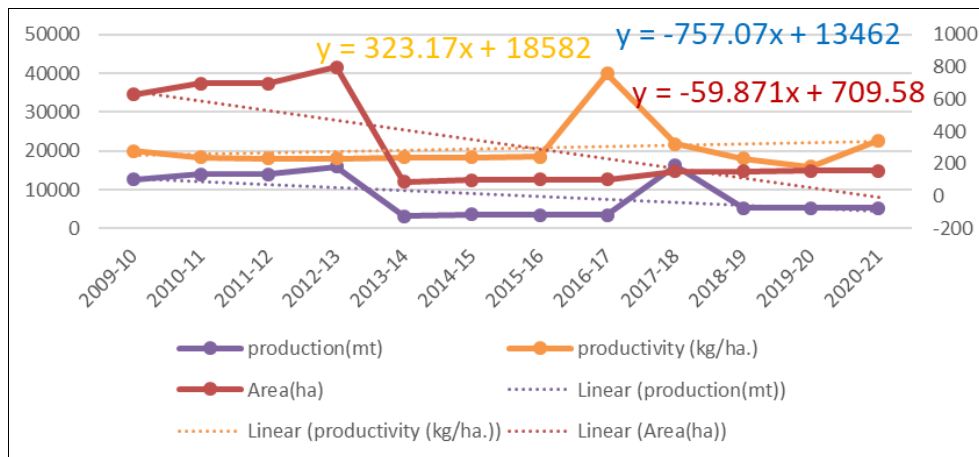


Fig 1: Trend and growth rate of area, production and productivity of papaya in Korba district

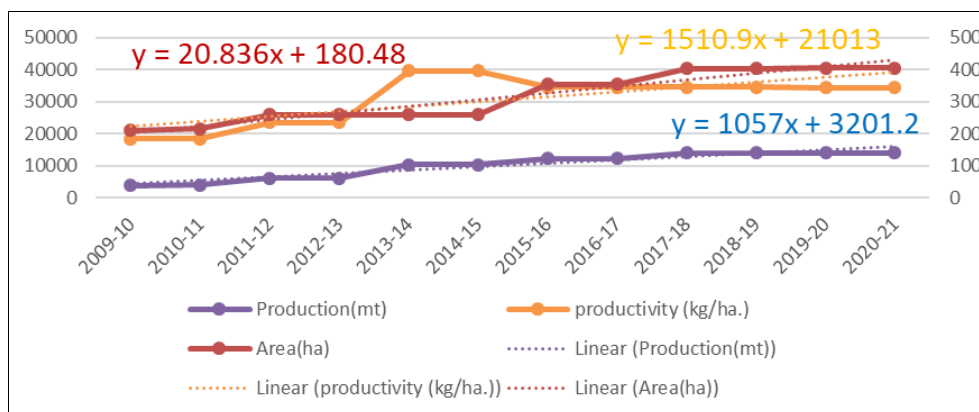


Fig 2: Trend and growth rate of area, production and productivity of papaya in Raigarh district

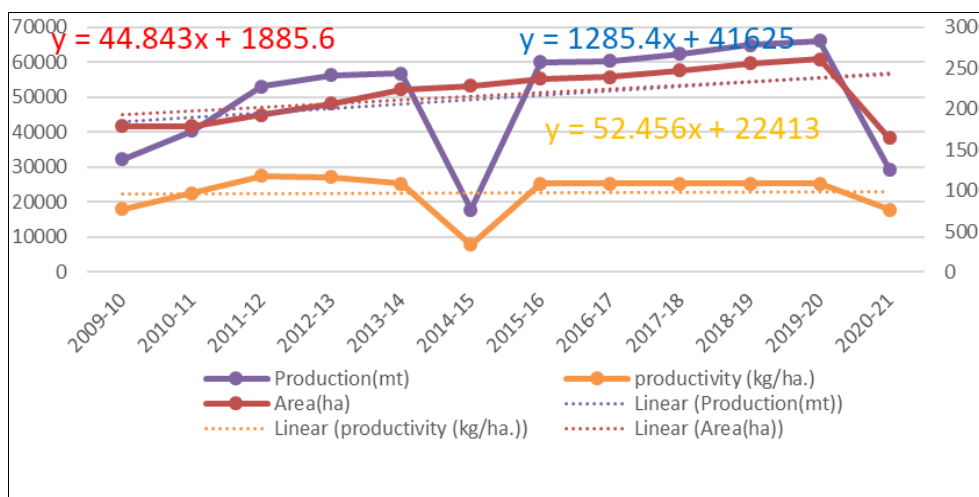


Fig 3: Trend and growth rate of area, production and productivity of papaya in Bilaspur district

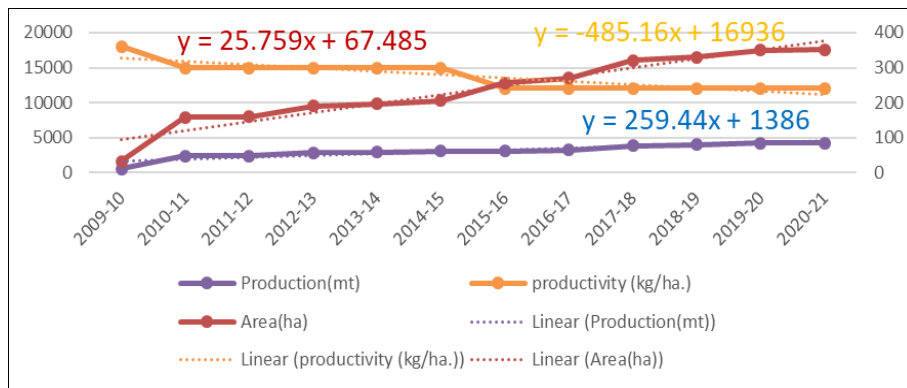


Fig 4: Trend and growth rate of area, production and productivity of papaya in Kabirdham district

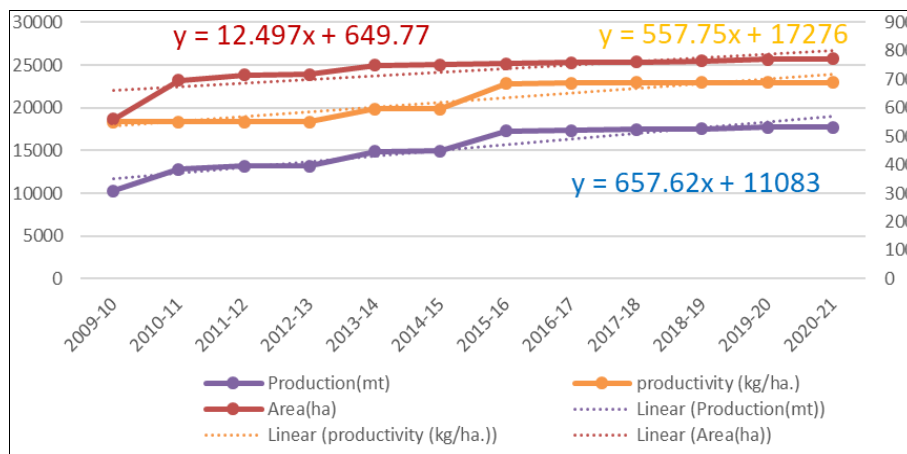


Fig 5: Trend and growth rate of area, production and productivity of papaya in Janjgir district

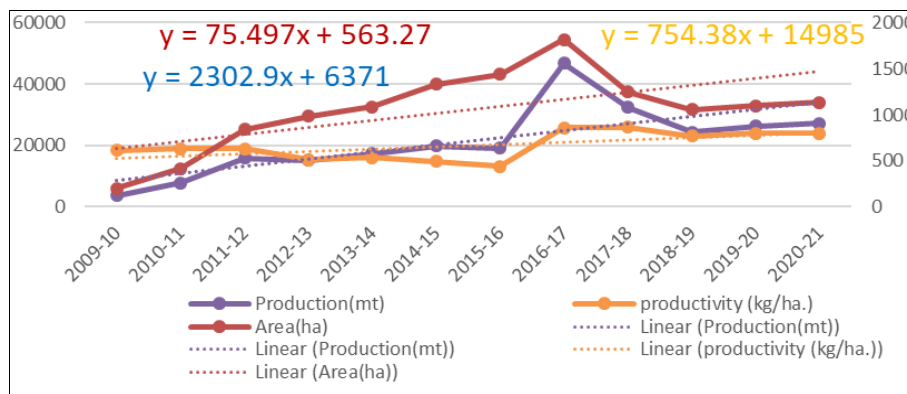


Fig 6: -Trend and growth rate of area, production and productivity of papaya in Mahasamund district

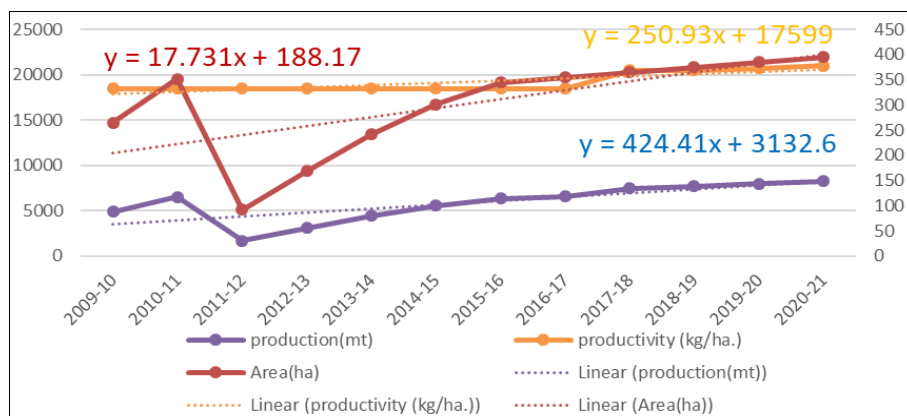


Fig 7: Trend and growth rate of area, production and productivity of papaya in Rajnandgaon district

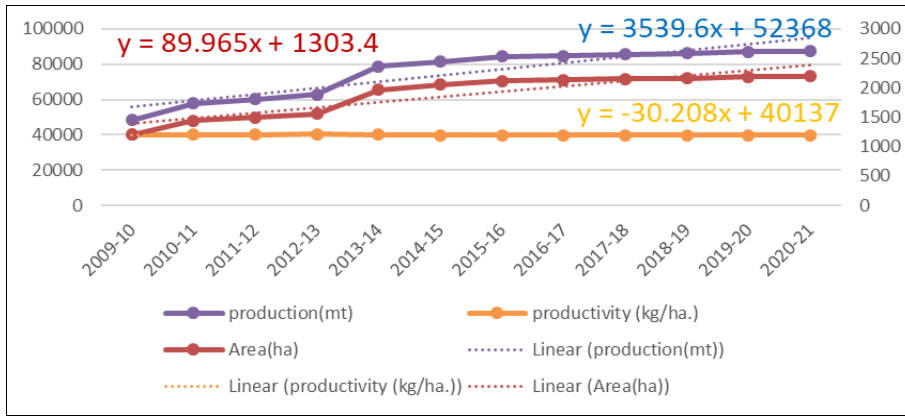


Fig 8: Trend and growth rate of area, production and productivity of papaya in Durg district

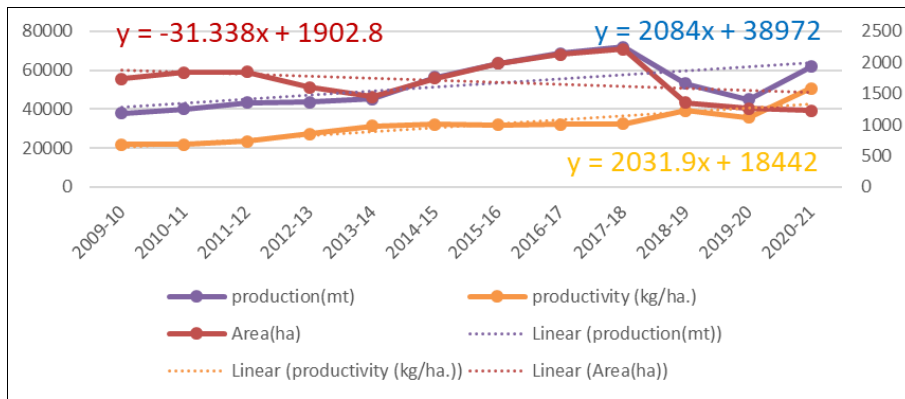


Fig 9: Trend and growth rate of area, production and productivity of papaya in Raipur district

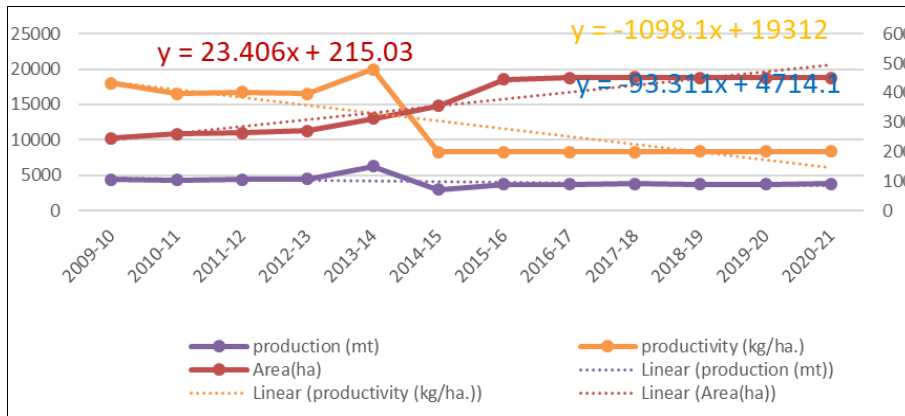


Fig 10: Trend and growth rate of area, production and productivity of papaya in Dhamtari district

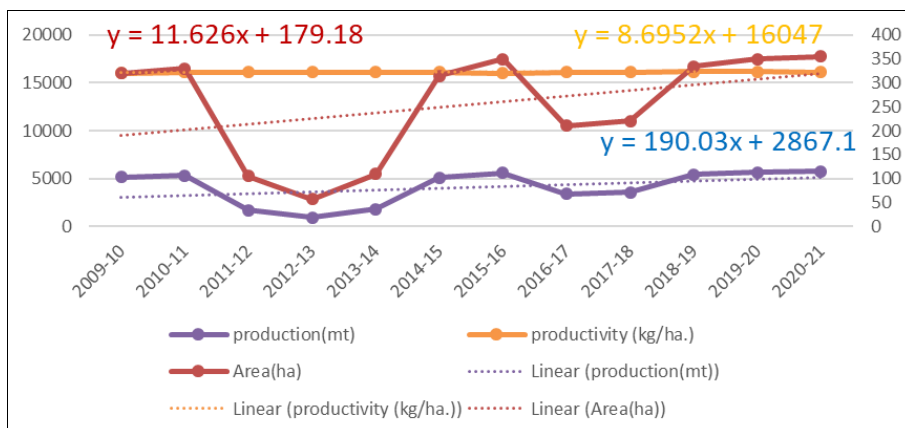


Fig 11: Trend and growth rate of area, production and productivity of papaya in Kanker district

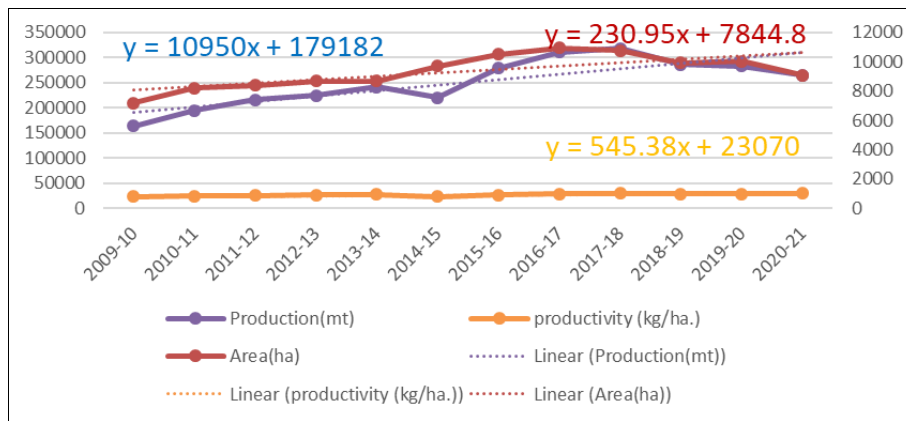


Fig 12: Trend and growth rate of area, production and productivity of papaya in Chhattisgarh plain zone

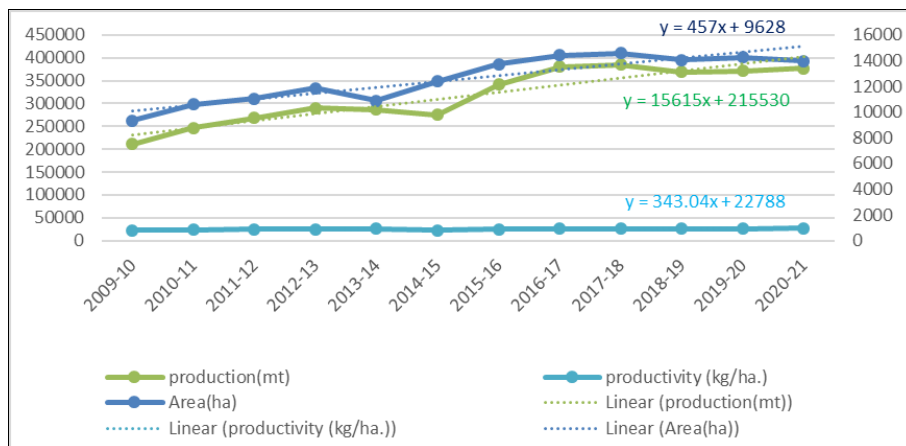


Fig 13: Trend and growth rate of area, production and productivity of papaya in Chhattisgarh State

4. Conclusion

Under the Area of Papaya, the trend coefficient and simple growth rate (SGR) of papaya area across Chhattisgarh plain zone districts showed mostly positive and significant results. Districts like Raigarh, Kabirdham, Janjgir, Mahasamund, Rajnandgaon, Durg, and Dhamtari showed increasing trends, with significant coefficients and positive SGRs, indicating a consistent rise in papaya area. Bilaspur and Kanker had positive but non-significant trends. However, Korba and Raipur showed declining trends, with Korba's decrease being highly significant. Overall, the Chhattisgarh plain zone recorded a significant annual increase of 457 ha in papaya area, with a trend coefficient of 457 and an SGR of 3.63%.

Under the Production, most districts in the Chhattisgarh plain zone showed a positive and significant trend in papaya production. Districts like Raigarh, Kabirdham, Janjgir, Mahasamund, Rajnandgaon, Durg, and Raipur recorded significant growth, while Bilaspur and Kanker showed non-significant but positive trends. Korba and Dhamtari showed decreasing trends. Overall, the zone exhibited a highly significant trend coefficient (15,614.55) and a simple growth rate of 4.93%, indicating an annual increase of 15,614.55 metric tonnes in papaya production.

Papaya productivity in most districts of the Chhattisgarh plain zone showed a positive trend. Districts like Raigarh, Bilaspur, Janjgir, Mahasamund, Rajnandgaon, and Raipur recorded significant increases, while Korba and Kanker showed non-significant but positive trends. However,

Kabirdham, Durg, and Dhamtari districts showed decreasing productivity trends. Overall, the zone showed a highly significant trend coefficient (343.04) with a simple growth rate of 1.37%, indicating an annual increase of 343.04 kg/ha in papaya productivity across Chhattisgarh.

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