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# To study the trends in growth of area, production and productivity of selected vegetables in Jaipur district of Rajasthan and the state as a whole

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**Abstract**
The growth in the area, production and productivity of tomato and green chilli crops in Jaipur district was estimated using the compound growth function. The necessary secondary data were collected for a period of 15 years from 2001-02 to 2015-16. Compound growth rates were estimated by using the exponential function of the form $Y=ab^tU_t$ .The growth rates in area, production and productivity of tomato and green chilli were estimated to be significantly positive and negative in the district of Jaipur and the State of Rajasthan during the period 2001-02 to 2015-16.

**Keywords:** growth, area, production, productivity, vegetables

## Introduction
India has witnessed voluminous increase in horticulture production over the last few years. Significant progress has been observed in the area expansion giving higher production. Over the last decade, the area under horticulture grew by about 2.7 per cent per annum and annual production enhanced by 7.0 per cent. During 2013-14, the production of horticultural crops was about 283.5 million tonnes from an area of 24.2 million hectares (ha). Out of the six categories, that are fruits, vegetables, flowers, aromatic, spices and plantation crops, the highest annual growth of 9.5 per cent was seen in fruit production during 2013-14. The production of vegetables has increased from 58,532 thousand tonnes to 1,68,3 00 thousand tonnes since 1991-92 to 2014-15 ($2^{nd}$ advance estimates).
India is endowed with a remarkably heterogeneous area, a great diversity of agro climatic zones, allowing for production of a variety of horticultural crops such as fruits, vegetables, flowers, spices, plantation crops, root and tuber crops, medicinal and aromatic crops. India is the second largest producer of fruits and vegetables in the world. India's diverse climate ensures availability of all varieties of fresh fruits and vegetables. It ranks second in fruit and vegetable production in the world, after China. As per National Horticulture Database published by National Horticulture Board, during 2014-15 India produced 86.602 million metric tonnes of fruits and 169.478 million metric tonnes of vegetables. The area under cultivation of fruits was 6.110 million hectares while vegetables were cultivated at 9.542 million hectares.
The vast production base offers India, tremendous opportunities for export. During 2015-16, India exported fruits and vegetables worth ₹ 8,391.41 crores that comprised of fruits worth ₹ 3,524.50 crores and vegetables worth ₹ 4,866.91 crores.

## Data and methodology
The secondary data with respect to the area, production and productivity of tomato and green chilli were collected from the records and reports of the Directorate of Economics and Statistics and Directorate of Agriculture, Government of Rajasthan, Jaipur.

## Compound Growth rates
To study growth rates in area, production and productivity of tomato and green chilli in Jaipur district and Rajasthan state, compound growth rates were worked out by using the following formula:

**Exponential equation**

$y_{t=ab^t u_t}$

Where,
$Y_t$ = Dependent variable in period t Area/ production/productivity of tomato and green chilli crop in the year
a = Intercept
b = Regression coefficient
t = Time element which takes the value 1, 2, 3----- n
$u_t$ = Disturbance term such that OLS assumptions are satisfied for its logarithmic transformation, a and b are constant or parameters to be estimated.
By taking logarithms of both the sides, the equation takes the form.

$\text{Log } Y_t = \text{Log}_a + t \text{ Log}_b + \text{Log } U_t$

The compound growth rates will be worked out as follows.
$g = (\hat{b} - 1) \times 100$
g = Estimated compound growth rate in per cent per year
$\hat{b}$ = Antilog of log b, *i.e.* log b

The standard errors of the growth rates will be computed by using the formula:

$$\text{S.E.(g)} = \frac{100b\ \sqrt{\frac{\sum(\log Y)^2 - (\sum logY)^2/N) - [\sum t^2 - (\sum t^2/N(\log t)^2/(N)(logb)^2]}{(N-2)[(\sum t)^2 - (\sum t)^2/N)]}}}{\log 10^e}$$

$\text{Log } 10^e = 0.4343$

N = Number of observations
S.E. (g) = Standard error of compound growth rate
Student't' test will be used for testing the significance of the compound growth rates.

$$t = \frac{g}{\text{S.E.(g)}}$$

$$d.f = N - 2$$

Where:
g = Compound growth rate in per cent per year
S.E. (g) = Standard error of compound growth rate
t = the variable which follows the 't' distribution with N-2 degrees of freedom at chosen level of significance

**Results and Discussion**

**Growth rates in area, production and productivity of tomato and green chilli**

This section deals with compound growth rates in area, production and productivity of tomato and green chilli in the district of Jaipur, State of Rajasthan. The aggregate production of a crop is the resultant effect of area and productivity of that crop. The growth pattern of area, production and productivity of tomato and green chilli in this context is important. The estimates of growth rates pertained to the period from 2001-02 to 2015-16.

**Table 1:** Compound growth rates in area, production and productivity of tomato in Jaipur District during 2001-02 to 2015-16 (Per cent per annum)

| Particular | Growth rate | Standard error | $R^2$ | t value |
|---|---|---|---|---|
| Area | 5.12*** | 0.55 | 0.88 | 9.37 |
| Production | -1.87 | 1.40 | 0.12 | -1.33 |
| Productivity | -6.65*** | 1.20 | 0.69 | -5.53 |

*** Significant at 1 per cent level of significance

Table 1 reveals that the area under tomato in the district of Jaipur registered a significantly positive growth rate of 5.12 per cent per annum during the period from 2001-02 to 2015-16. Productivity decreased with a significantly negative rate of -6.65 per cent per annum. The significant decrease in yield nullified the effect of significant increase in area causing the production to be stagnant (non-significant decrease at the rate of -1.87 per cent per annum). The overall productivity under tomato revealed to be decreasing annually. The decline in productivity may be due to attack of insect pest and disease and other climatic factors during period 2010-11 to 2013-14. The similar results were reported by Rajur *et al.* (2008).

**Table 2:** Compound growth rates in area, production and productivity of tomato in Rajasthan during 2001-02 to 2015-16 (Per cent per annum)

| Particular | Growth rate | Standard error | $R^2$ | t value |
|---|---|---|---|---|
| Area | 2.85*** | 0.57 | 0.67 | 5.03 |
| Production | 5.36*** | 1.13 | 0.64 | 4.73 |
| Productivity | 2.44** | 0.87 | 0.38 | 2.79 |

*** Significant at 1 per cent level of significance
** Significant at 5 per cent level of significance

The table 2 reveals that tomato crop registered a significant growth rate of 2.85 percent per annum in area at 1 per cent level of significance for Rajasthan. On the other hand, production increased at a significant compound growth rate of 5.36 per cent per annum also significant at 1 per cent level of significance. The growth rate of productivity for tomato was registered to be significantly positive (2.44 per cent per annum) at 5 per cent level of significance.
The coefficient of determination ($R^2$) was 0.67, 0.64 and 0.38 indicating that 67, 64 and 38 per cent of variation in area, production and productivity was due to time. The results indicate that the increased area under the crop as well as the productivity could increase the production of tomato crop in Rajasthan.

**Table 3:** Compound growth rates in area, production and productivity of green chilli in Jaipur District during 2001-02 to 2015-16 (Per cent per annum)

| Particular | Growth rate | Standard error | $R^2$ | t value |
|---|---|---|---|---|
| Area | 7.02*** | 1.28 | 0.71 | 5.48 |
| Production | 2.11 | 2.12 | 0.07 | 0.99 |
| Productivity | -4.59 | 2.43 | 0.21 | -1.89 |

*** Significant at 1 per cent level of significance

It is observed from the table 3 that growth rate in area, and production of green chilli in Jaipur district for the period 2001-02 to 2015-16 registered positive at 7.02 per cent and

2.11 percent respectively. But the productivity growth rate was negative (-4.59) per cent per annum. The coefficient of determination ($R^2$) was 0.71, 0.07 and 0.21 indicating 71, 7 and 21 per cent of variation in area, production and productivity was due to time.

**Table 4:** Compound growth rates in area, production and productivity of green chilli in Rajasthan during 2001-02 to 2015-16 (Per cent per annum)

| Particular | Growth rate | Standard error | $R^2$ | t value |
|---|---|---|---|---|
| Area | 7.93*** | 2.55 | 0.44 | 3.10 |
| Production | 5.61 | 3.54 | 0.17 | 1.58 |
| Productivity | -2.15 | 1.82 | 0.09 | -1.18 |

*** Significant at 1 per cent level of significance

Table 4 the state registered a highly significant increase in area under green chilli 7.93 percent per annum during the study period. The production of green chilli showed an annual positive growth of about 5.61 per cent per annum. The green chilli productivity in the state witnessed an annual decrement of -2.15 per cent per annum. The growth in the production of green chilli in the state has come mainly from growth in the green chilli area. The coefficient of determination ($R^2$) was estimated to be 0.44, 0.17 and 0.09 indicating 44, 17 and 9 per cent of variation in area, production and productivity was explained by the time variable.

## Conclusions

The compound growth rates of area, production and productivity of tomato and green chilli were estimated to be significantly positive and negative in the district of Jaipur and the state of Rajasthan during the period 2001-02 to 2015-16. The overall productivity under tomato revealed to be decreasing annually. The decline in productivity may be due to attack of insect pest and disease and other climatic factors.

## Recommendations

The production of tomato and green chilli in Jaipur district did not record any significant growth inspite of significant increase in area under them, the reason being significant/ non-significant decrease in productivity. Hence there is a need to identify the reasons for decline in yield and to take corrective steps for increasing the yield of these vegetable crops.

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