



Growth Trend in Area, Production and Productivity of Tomato in India and Haryana

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HIGHLIGHTS

- Promoting the adoption of sustainable farming practices, precision agriculture, value-added processing and tapping export opportunities is essential.
- R^2 value for area, production and productivity of tomato in India was 0.6976, 0.8967 and 0.9112 indicating a good fit.
- Compound annual growth rate for area, production and productivity in India was 3.25, 5.90 and 2.56 whereas it was 3.82, 6.63 and 2.70 per cent in Haryana.

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ABSTRACT

Tomato an economically important crop contributes significantly to horticulture production. The study was based on the secondary data regarding production, productivity and area of tomato in Haryana and India. The data was collected from various secondary resources like reports from the National Horticulture Board, Indiatat.com, horticulture statistics at a glance, agriculture statistics at a glance, and the Department of Agriculture, Cooperative and Farmers Welfare. The analysis of data was done by calculating compound annual growth rate (CAGR) and regression charts. The study concluded that tomato production in the state of Haryana and India witnessed a significant increase from 2001-02 to 2021-22. The area under tomato cultivation in Haryana and India also exhibited a positive trend. The compound annual growth rate of area, production and productivity of tomatoes in India was 3.25, 5.90 and 2.56 whereas it was 3.82, 6.63 and 2.70 per cent respectively, in Haryana. It was suggested to promote the adoption of sustainable farming practices such as integrated pest management, precision agriculture and use of high-yielding varieties among tomato growers, to enhance productivity. Better market linkages and infrastructure for value-added processing should be developed to reduce post-harvest losses and ensure better returns to farmers.

INTRODUCTION

Vegetables production witnessed substantial stake in horticultural sector with considerable growth in India and Haryana. The vegetable output climbed from 101.2 million Tons to 197.23 million Tons in a period from 2004-05 to 2021-22 (Ministry of Agriculture and Farmers Welfare, 2022). Haryana, with a production of 440 thousand tons, ranks 14th in tomato production of India (National Horticulture Board, 2021-22). Vegetable cultivation in outdoor conditions has to bear many constraints based on biotic

and abiotic factors. There is a huge demand for high quality and off-season vegetables and vegetable growers can fetch reasonable prices for their produce in off-season. Factors such as, a shift in farmer's interest in growing high value vegetables due to their higher returns over short crop period, increased per capita income and shift in health awareness directed rise in both area and production of vegetables. There is large growth in tomato products over a couple of years throughout the world. Tomato is equipped with the significant demand among all the vegetables in India, consumed

by all levels of people whether they are poor or rich, urban or rural. It is fundamentally essential and prime item in daily consumption pattern of all Indian households, but fluctuation in its prices prominently impacting their consumption behavior. This advocates the demand for better handling of the crop before and after harvest since all the stakeholders of tomato supply chain faces consequences of the frequent variation in prices caused by supply chains breakdowns, lack of awareness and the poor decision making. In 2021-22, approximately 20300.19 tons of tomato were produced in the country making up almost 9.63 per cent of the total vegetable production. The area under tomato has climbed 865.29 million hectares in 2021-22 from 546.93 million hectares in 2005-06 resulting into production of 20300.19 tons from 99.67 thousand tons in 2005-06 (Department of Agriculture & Farmers Welfare, 2022). Tomato is growing round the year as per the weather suitability in different locations of the country. It has advantage of both, domestic consumption and the international demand as well (Anamika et al., 2023). Haryana and India have witnessed increase in production, productivity and area under tomato continuously over the last decade (Kumar et al., 2016). India has 2nd rank in both area and production of tomato worldwide after China (Harisha et al., 2019 & Gupta et al., 2021). Despite its high production in India, average productivity level remains low as compared to other tomato producing countries. In recent decades, India has witnessed considerable growth in production and productivity of tomato. This growing trend has been influenced by various factors such as technological advancements, improved farming practices, changing market dynamics, climate change, government policies and increasing demand globally. The study was carried out for analyzing the trend to show growth trend in production, productivity and area under tomato cultivation in India and Haryana.

METHODOLOGY

The study was conducted with objective to analyze the growth trends in area, production and, productivity of tomato in state Haryana and India from 2000-01 to 2021-22. The methodology employed a combination of statistical tools and quantitative analyses to derive insights from the time series secondary data collected from various sources. The data for area, production and productivity under tomato in India was collected from Indiatat.com whereas data for Haryana was collected from statistical abstract of Haryana. The books entitled Horticulture Statistics at a glance and agriculture statistics at a glance were also concerned with the required data. The first step involved collecting comprehensive data on tomato area, production, and productivity spanning the twenty-one-year period. The data included for analysis for tomato area, production, and productivity were annual figures, leading for a detailed analysis of trends and fluctuations over time. To analyze the trend of tomato area, production, and productivity, the data was plotted against independent variable as time (years) and dependent variable as area, production and productivity separately to compute R^2 from regression trend line using linear regression. The graphical representation of regression charts was used to visualize growth pattern with individual data points for each year, representing the actual values for production, area, and productivity of tomatoes in India and Haryana. R^2 values also

measure how well it fits the data. The value of R^2 ranges from 0-1, with higher values indicating a better fit. Area trend indicates overall trend over a period of time in the area under tomato cultivation. Production trend indicates overall trend in tomato production over time, which can be influenced by factors such as area, yield, climate and sustainable farming practices. Productivity trend indicates trend in efficiency of tomato production, which reflects improvements in inputs, technology advancements, precision farming techniques, improved varieties, management practices and better prices. To analyze the growth rates of tomato area, production and productivity, the Compound Annual Growth Rate (CAGR) was calculated using linear regression statistics in excel. CAGR provides a measure of the average annual growth rate, assuming compounding over the specified period. By employing these methodologies, this study aimed to offer an all-inclusive and comprehensive analysis of the trends and growth rates in tomato area, production and productivity in India and state Haryana over the period of twenty-one years from 2001-02 to 2021-22, thus contributing a profound understanding of the dynamics determining the tomato industry.

RESULTS

Growth in area, production and productivity of tomato in India

The growth trend in production, productivity and area of tomato in India were analyzed for the period 2001-02 to 2021-22 and presented in Table 1 and trend analysis with R^2 . Area under tomato was 458.10 thousand hectares during 2001-02, which increased to 841 thousand hectares during 2021-22 with a fluctuation of up and down in between the years. The area under tomato registered an increase by 3.98 per cent per annum during 2001-02 to 2021-22. The average productivity is hiked from 16.29 t/ha during 2001-02 to 24.18 t/ha during 2021-22 by registering an increase of 2.31 per cent per annum. This increase in productivity from past years was due to efficient use of improved technologies, high yielding varieties, manures and fertilizers and plant protection chemicals. The positive and constructive growth in area and productivity resulted into expansion of overall production of tomato in India from 7462.30 thousand metric tons in 2001-02 to 20336 thousand metric tons in 2021-22, registering an annual increase of 8.22 per cent during 2001-02 to 2021-22. The annual compound growth rate was worked out to be 3.25 per cent for the area and 2.56 per cent for productivity which resulted into an increase of production at a yearly compound growth rate of 5.90 per cent (Table 1). However, the growth rates were found to be statistically significant at 1%. There is a decreasing trend in production, productivity and area in India after 2017-18 to 2021-22 continuously due to extreme climate change causing extreme heat and cold waves, disrupted supply chain, unpredictable rainfall patterns, Covid, insect, pest and disease outbreak, fragmented landholdings, and price fluctuations.

During last period of 21 years, tomato crop in India registered an annual increase in area at the rate of 20.85 thousand hectares, 773.78 thousand metric tons in production and 0.512 tons per hectare in productivity, respectively. The value of R^2 for production and productivity of tomato in India were 0.8967 and, 0.9112 tending towards higher side and a good fit whereas for area it was

Table 1. Growth in area, production and productivity of tomato in India

Year	Area (000 ha)	Production (000 MT)	Productivity (t/ha)
2001-2002	458.10	7462.30	16.29
2002-2003	478.80	7616.70	15.91
2003-2004	502.80	8125.60	16.16
2004-2005	505.40	8825.40	17.46
2005-2006	546.93	9967.60	18.22
2006-2007	596.23	10054.61	16.86
2007-2008	566.30	10302.74	18.19
2008-2009	599.11	11148.83	18.61
2009-2010	634.39	12433.19	19.60
2010-2011	864.92	16826.45	19.45
2011-2012	907.05	18653.30	20.56
2012-2013	879.63	18226.64	20.72
2013-2014	882.03	18735.91	21.24
2014-2015	767.32	16384.98	21.35
2015-2016	773.88	18731.97	24.21
2016-2017	796.86	20708.43	25.99
2017-2018	789.15	19759.32	25.04
2018-2019	781.01	19007.24	24.34
2019-2020	817.78	20550.11	25.13
2020-2021	865.29	21055.85	24.33
2021-2022	841.00	20336.00	24.18
Average	707.33	14995.87	20.66
Annual %tage change	3.98	8.22	2.31
CAGR	3.25**	5.90**	2.56**

Note: Significant at **1% level and *5% level;

Source of data: Indiatat.com

0.6976 indicating moderate fit. The increase in productivity and production over a period of time is more statistically significant and good fit as compared to growth in area under tomato cultivation in India.

Growth in area, production and productivity of tomato in Haryana

The growth in area, production and productivity of tomato in Haryana were analyzed for the period of 2001-02 to 2021-22 and results are presented in Table 2. The results shows that the area under tomato was 115.95 thousand hectares during 2001-02 which was increased to 208.91 thousand hectares by registering an increase by 3.82 per cent per annum during 2001-02 to 2021-22. The average yield or productivity increased from 14.25 MT/hectare during 2001-02 to 16.29 MT/hectare during 2021-22 registering an increase by 0.68 per cent per annum. This positive growth in area as well productivity resulted into a boost in production of tomato in Haryana which was 1651.80 thousand MT in 2001-02 to reached ever highest 3403.06 thousand MT in 2021-22 registering an annual increase of 5.05 per cent during period of 2001-02 to 2021-22. The annual compound growth rate was worked out to be 3.82 per cent for area and 2.70 percent for productivity resulted into a boost in production to grow at a yearly compound growth rate of 6.63 percent due to increase in area and productivity under tomato (Table 2). The growth rates were found

to be significant at one and five percent level. The continuous growth was due to efficient use of improved technologies, high yielding varieties, fertilizers and plant protection chemicals. It can be seen from the table 2 that from 2018-19, area, production and productivity has shown decreasing trend, and this is due to effect of heat waves, frequent price fluctuations, inefficient supply chains, post-harvest losses and climate change.

It is evident and clear that during last 21 years, area, production and productivity of tomato crop in Haryana registered an annual increase at the rate of 7.57 thousand hectares, 230.99 thousand MT and productivity at 0.45 MT/ha, respectively. The value of R^2 for area, production and productivity of tomato in Haryana were 0.5049, 0.572 and, 0.477 tending towards lower side and indicating not a good fit.

DISCUSSION

The trend analysis of production, area and productivity of tomato in India and Haryana provides valuable insights into the understanding growth patterns and challenges in tomato production. The tomato industry witnessed a remarkable growth and holds significant potential for further growth in future through adoption of sustainable farming practices, value added processing and export opportunities. The significant growth in tomato production, area and productivity attributed to many factors such as technological advancements, improved infrastructure, government support, changing market dynamics, climatic conditions and consumer

Table 2. Growth in area, production and productivity of tomato in Haryana

Year	Area (000 ha)	Production (000 MT)	Productivity (MT/ha)
2001-2002	115.95	1651.80	14.25
2002-2003	130.60	1588.10	12.16
2003-2004	140.36	2228.15	15.87
2004-2005	137.60	2197.01	15.97
2005-2006	171.16	2572.82	15.03
2006-2007	225.33	2587.58	11.48
2007-2008	191.82	2023.29	10.55
2008-2009	220.41	3162.67	14.35
2009-2010	226.06	3798.28	16.80
2010-2011	272.25	3716.82	13.65
2011-2012	270.70	4174.43	15.42
2012-2013	276.05	4008.11	14.52
2013-2014	294.20	6272.80	21.32
2014-2015	272.50	6665.60	24.46
2015-2016	290.30	6753.80	23.26
2016-2017	318.20	6435.90	20.23
2017-2018	349.90	7537.20	21.54
2018-2019	301.15	6435.48	21.37
2019-2020	239.23	4935.49	20.63
2020-2021	213.19	4402.03	20.65
2021-2022	208.91	3403.06	16.29
Average	231.71	4121.45	17.13
Annual %tage change	3.82	5.05	0.68
CAGR	3.82**	6.63**	2.70**

Note: Significant at **1% level, *5 level

Source: Statistical Abstract of Haryana and Indiatat.com

demand globally. Indian vegetable cultivation reflected a remarkable past and a bright future ahead (Dastagiri et al., 2013). Productivity, measured as yield per unit area, has also demonstrated a gradual improvement in India. Tomato productivity in Haryana was not so significantly increased, but in India, yield upsurged significantly. The study reported that Haryana has potential scope to increase yield by using high yielding varieties, modern agricultural practices and government policies (Nimbrayan et al., 2022). Sharma & Nandal (2019) also reported that Haryana possessed positive trend in area, production and productivity of tomato. India shows positive and increasing trend in area, production and productivity overall from year 2001 to 2022 but with steady up and down in between years. There is declining trend in area, production and productivity of tomato in India from 2018 onwards (Singh et al., 2023). There is a pressing need to improve productivity in order to increase the production and meeting vegetables' demand of expanding population. It requires a necessary investment in quality inputs, marketing infrastructure and transportation facilities (Kumar et al., 2023 & Priyadarshini et al., 2020). The interventions by extension agencies, educators and service providers have contributed to the expansion of area under cultivation of tomato, increased production and improved productivity through continuous efforts in research conduct, dissemination of technology, training, capacity building, farmer mobilization and market linkages. The knowledge without adoption in practical is of no use. The proper balance in demand and supply of tomatoes in market will help in reducing problem of price fluctuations due to shortage or over production of tomato. The CAGR for area, production and productivity of tomato was 0.95, 3.33 & 2.36 per cent in India, implied positive and significant increasing trend in area, production and productivity in Haryana than India (Gholap et al., 2021). The production and productivity of tomato faces many challenges like pest and disease management, extreme climate change like rising temperatures and inadequate postharvest losses results in poor productivity and inefficiency in tomato cultivation (Anamika et al., 2023). Climate change is affecting production badly and sometimes there is complete failure of crops (Mishra et al., 2024). These challenges need to manage carefully to turn these challenges into opportunities for tomato growers to gain better returns for their investment by adopting advanced technologies and expanding their market reach. By addressing these challenges carefully, tomato producers can capitalize on opportunities, can also strengthen their position as major tomato producers and contribute to global food supply. The decrease in production, productivity and area of tomato in India and Haryana from 2018 was due to pest and disease outbreaks, climate change, inadequate post-harvest losses, price and market fluctuations, labor shortages and high labor charges. All these factors contributing in continuous decline of area, production and productivity (Babu et al., 2024). Multi-pronged approach involving government policies, research and development, education and awareness to farmers is required as knowledge with proper adoption will ultimately help in blooming tomato industry. Implementation of sustainable agricultural practices, investing in research, improving postharvest infrastructure and market support are crucial towards reversing this declining trend and ensuring long-term sustainability of tomato production in India and Haryana.

CONCLUSION

This increase in cultivated area can be attributed to increased climatic adaptability and adoption of short crop duration. Moreover, the growth is primarily driven by use of high yielding varieties, technological advancements, improved infrastructure, government support and consumer demand through continuous efforts in technology dissemination capacity building and market linkages. The tomato industry holds significant potential in terms of value-added processing and export opportunities. On the basis of the results of the study, it is suggested to promote the adoption of sustainable farming practices, bamboo-based cultivation, polyhouses at farmer's end whereas government should work on balancing demand and supply of tomato to avoid problem of price fluctuation with enhanced and poor production of tomato over time. Value added processing and exports of tomatoes to tap global markets should be encouraged to increase profitability, reduce wastage and generate additional income for farmers.

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