Original Research Article

Trend Analysis of Area, Production and Productivity of Tomatoin Uttar Pradesh

Abstract

India has access to several natural resources because of its diverse Agro-climatic conditions and a wide-ranging and large raw material base suitable for vegetable cultivation. This study was purely based on secondary data as collected from reports from Horticulture at a Glance, Agriculture at a glance and the Indiastat site.The trends of area, production, and productivity were estimated from the period 2001–2002 to 2021–2022, under tomato cultivation. The Study period was further divided into three subperiods: period I (2001–2010), period II (2011–2022), and the overall period (2001–2022).The compound growth rates of area, production, and productivity computed at the national level was2.93 percent, 4.89 percent, and 1.89 percent, respectively and in Uttar Pradesh it was found 3.80, 13.22 and 9.10 percent. This study showed that the percentage share of Uttar Pradesh under Tomato cultivation was higher than in the whole of India.

Key words: Tomato, Compound Annual Growth Rate, Area, Production and Productivity.

Introduction

India is a prominent player in the global agriculture sector and the primary source of income for 55% of India's people. India's diversified climate allows for the availability of an extensive array of fresh fruits and vegetables. Agricultural and processed food products export development authority (APEDA) estimates that the area under cultivation for vegetables is 10.86 million hectares in India.With a population of about 200 million, Uttar Pradesh is India's most populous state. Uttar Pradesh borders Nepal on the north, the Indian states of Uttarakhand and Himachal Pradesh on the northwest, Haryana, Delhi, and Rajasthan on the west, Madhya Pradesh on the south, Chhattisgarh, and Jharkhand on the southeast, and Bihar on the east. The gross state domestic product (GSDP) of Uttar Pradesh is estimated to be Rs. 20.48 trillion (US$ 248.66 billion) in 2022-23 at current prices and the agricultural sector's gross domestic product in the northern Indian state of Uttar Pradesh was approximately three trillion Indian rupees in fiscal year 2022. Apart from fiscal year 2015, the state's gross domestic product has consistently increased since fiscal year 2012 (Statista,2023). Several causes, including an increase in per capita income, a rise in health consciousness, a shift in farmers' cultivation of better-value vegetables due to higher returns, etc., have contributed to an increase in the area and output of vegetables (Nimbrayan *et al*., 2022). In terms of production, China leads the world with a share of 27.8%, followed by India with a share of 11.2% (Kumar *et al*., 2016; Harisha *et al*., 2019; Gupta *etal*., 2021).

Despite India's limited share of the global market (almost 1%), horticulture items are getting increasingly popular (APEDA, 2023). This is due to advancements in the domains, such as cutting-edge cold chain infrastructure and quality assurance measures, occurring concurrently. Aside from large private-sector investments, the government has also led the way in constructing several centres for Perishable Cargoes and integrated post-harvest processing facilities across the country in collaboration with APEDA. This approach has also benefited from capacity-building programmes at the farmer, processor, and exporter levels.

Increased investment in agricultural infrastructure such as irrigation, warehousing, and cold storage is expected to propel India's agriculture sector forward in the next years. Indian vegetable cultivation reflected a glorious history and a hopeful future (Dastagiri et al. 2013). As a result, there are opportunities to boost tomato productivity through technology and innovation. Agriculture and associated activities achieved a growth rate of

3.9% in 2021-22 (till 31 January 2022) (IBEF,2023) and is predicted to climb to US$ 24 billion by 2025.

Method and Material

The data for the present study was completely based on secondary data. The compound annual growth rate of area, production, and productivity under tomato cultivation was estimated.Uttar Pradesh was specifically chosen because Uttar Pradesh has grown to have the highest proportion of horticulture crops, formerly ranking second after West Bengal.The information was gathered from horticulture at a glance report and the National Horticulture Board.The study period was from 2001-2002 to 2021-2022. The period was further subdivided into three sub-periods: period I, period II, and the total period from 2001 to 2010, 2011-2022, and 2001 to 2022. The following growth rates were estimated using the exponential growth functional form:

Estimation of growth trend

Growth rate is calculated to examine the tendency of variables to increase, decrease or constant over a period of time. It also indicates the magnitude of the rate of change, in per unit of time of the variables under consideration.

The rate of change of "Yt" per unit of time to express as a function of the magnitude of "Yt" itself is usually termed as the compound growth rate (CGR) which can be expressed mathematically as:

$$CGR = [(1/Yt)(dYt/dt)] = [(Yt+1 - Yt/Yt)] \ldots\ldots\ldots\ldots (1)$$

The above expression if multiplied by 100 gives the compound growth rate of "Yt" in percentage term. There are many alternative forms of growth function viz., linear, exponential, modified exponential, Cobb-Douglas etc. which have been developed and used by the researcher (Dastagiri and *et al.*, 2013). The mathematical form of log-linear function (also known as exponential function) is as follows:

$$Yt = Ae^{bt} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The log transformation of equation (2) is as follows:

$$\text{Log e } Y_t = \log_e A + b_t$$

Differentiating the equation (2) with reference to “t” gives,

Or,

The formula for calculating Compound Growth Rate (CGR) from the log-linear equation can be derived as follows:

Let “Y_0” be the value of variable under study in the base period.

“Yt” be the value of variable in time “t”.

“Y” be the value of Compound Growth Rate (CGR) then using the compounding formula,

We get,

$$Yt = Y0 (1 + r) t$$

Log – transformation of the above i.e.

$$Log\ Yt = logY0 + t \log (1+r)$$

Assuming

$$Log\ Y0 = log\ A$$

$$Log (1+r) = b,$$

The same expression can be put as-

$$Log\ Yt = log\ A + b^{t}$$

From the log-linear form, CGR can be worked out as follows:

By differentiating,

But, the estimate of “b” in the log-linear function is in semi-log terms. Therefore, to convert it into the original form of Yt following transformation is done

Since $b = \log (1+r)$

$Antilog (b) = 1 + r$

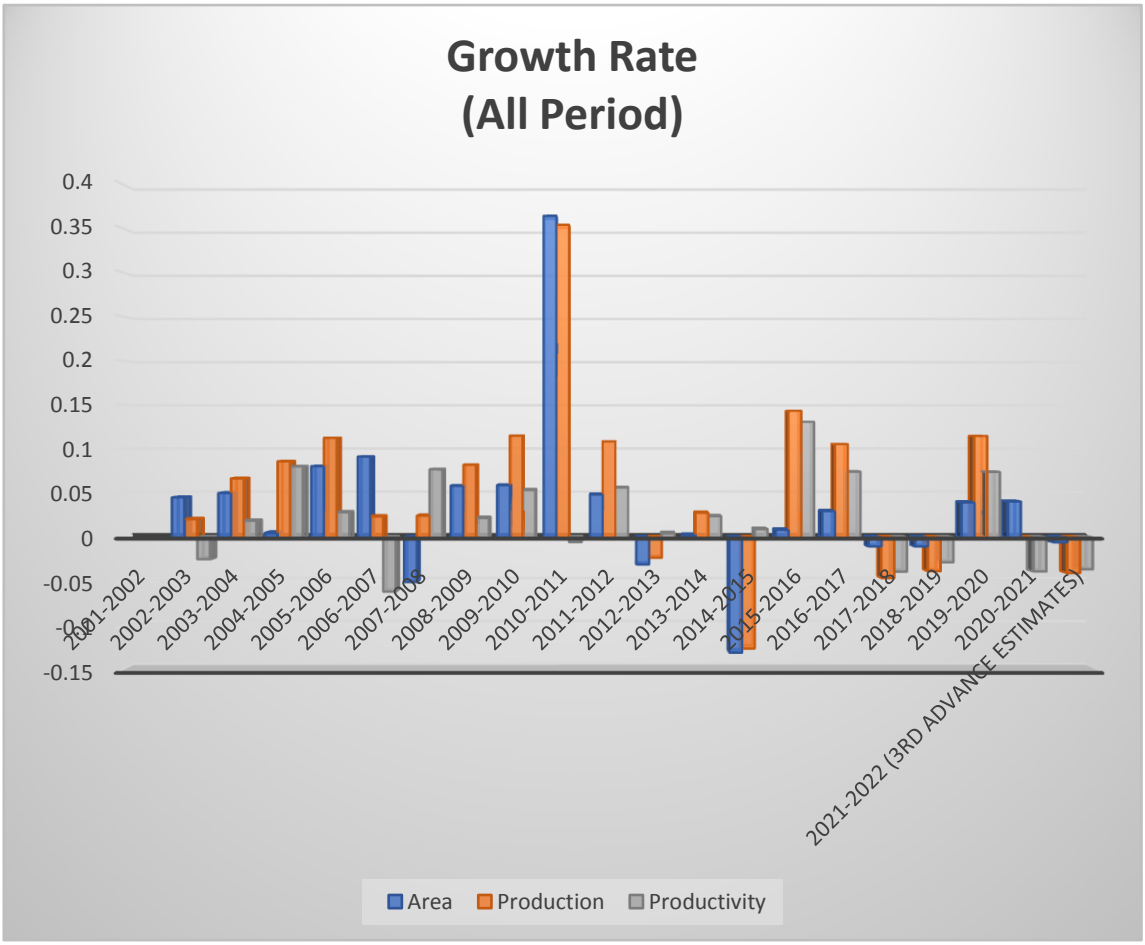
$r = (Antilog\ “b”) – 1$

$CGR\ in\ percentage = [(Antilog\ “b”) – 1] \times 100$

Results and Discussion

Period Between 2001-**02 to 2005-06 Area, production and productivity of tomato was found increasing trend but 2002-03 and 2006-07 area was in decreasing trend. In 2007-08 area under tomato cultivation was found in declining trend and production and productivity was in increasing trend, this shows the positive impact of the innovation done by the researcher. After 2007-08 area, production and productivity was in increasing trend and 2012-13 minimal increase was seen in productivity but area and production were decline. Same results were found in 2014-15. From 2016-16 to 2016-17 area, production and productivity was in increasing trend but 2017-18 to 2018-19 and2020-21 to 2021-22 it was observed in declining term were represented by fig. 1.**

Fig 1: **Compound Annual Growth Rate of area, production, and yield of Tomato during all Period**



The area under tomato cultivation in India was 458.1 thousand hectares in 2001–02, with a compound annual growth rate reaching 840.3 thousand hectares in 2021–22. During 2001-2002, the total area under tomato cultivation in Uttar Pradesh was 10.40 thousand hectares, with a growing pattern reaching 22.79 thousand hectares in 2021-22(Table 1). In India, the area under tomato cultivation increased by 6.56 percent during period I, declined by 0.69 percent during period II, and again jumped by 2.93 percent in overall period. In Uttar Pradesh, compound annual growth rate initially showing negative trendi.e., 1.90 percent in period-I and27.31 percent and 8.53 percent were reported positively increasing trend throughout periods-II, and III, indicating a favourable trend (Table 1).

In India, total tomato output in 2001–02 was 7462.3 thousand Metric Tonne (MT), and it increased to 20331.4 thousand MT in 2021–22, with a positive growth trend and a compound annual growth rate of 4.89 percent. Similarly, the growth rate of productionin Uttar Pradesh was 13.22 percent, and increasing from 67.00 thousand MT in 2001-02 to 909.35thousand MT in 2021–22. In India, the highest growth trend was 8.47 percent during

period I and the lowest was 0.78 percent during period II and in Uttar Pradesh declining growth trend was found i.e., 7.65 percent during period-I.During period-II under tomato cultivation in Uttar Pradesh highest growth rate was recorded with 80 percent variation.

In India, the compound annual growth rate of productivity under tomato cultivation was 1.89 percent, increasing from 16.3 MT/Ha in 2001-02 to 24.2 MT/Ha in 2021-22. The overall output under tomato production in Uttar Pradesh for 2001-2002 was 6.40 MT/Ha, with an upward trend reaching 39.90 MT/Ha (Table 1). The highest growth rate was 1.89 percent recorded during overall period in India and lowest was 1.47 percent during period-II. 9.10 percent was highest compound annual growth rate was recorded in Uttar Pradesh during overall period and lowest was period-I i.e., 1.25 percent (Table 1).

Table 1: Compound Annual Growth Rate of Area, Production and Productivity of Tomato in India

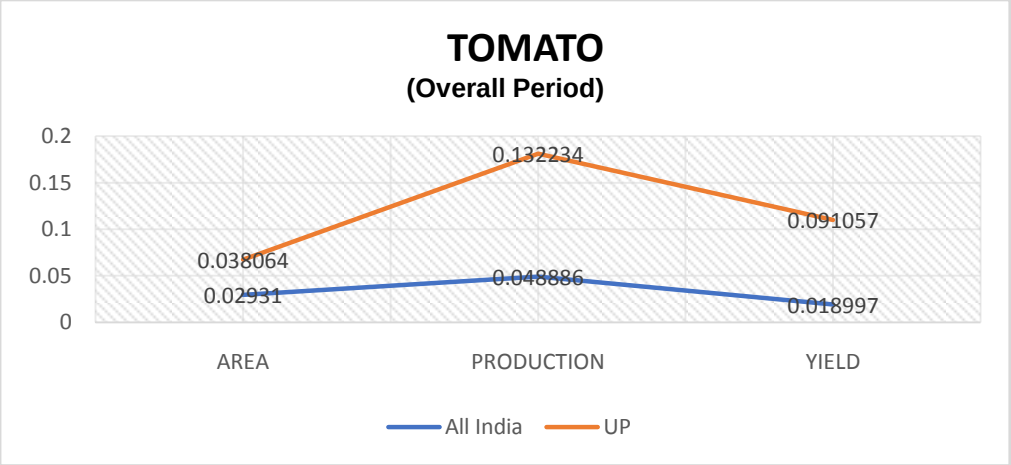
TOMATO								
SR. NO.	Particulars		Period-I (2001-11)		Period-II (2011-22)		Overall Period (2001-22)	
			India	**U.P.**	**India**	**U.P.**	**India**	**U.P.**
1	Area (000' Ha)	Initial Value	458.1	10.40	907.1	1.60	458.1	10.40
		End Value	865	1.26	840.3	22.79	840.3	22.79
		CAGR (%)	6.56*	-19.0*	-0.69	27.31*	2.93	3.81*
		Std. Error	63.31	2.16	47.14	3.63	88.15	5.71
		R^2 (%)	73.83	70.45	15.70	80.38	68.79	43.79
2	Production (000' MT)	Initial Value	7462.3	67.00	18653.3	38.70	7462.3	67.00
		End Value	16826	30.20	20331.4	909.35	20331.4	909.35
		CAGR (%)	8.47*	-7.66	0.79*	33.24*	4.89	13.22
		Std. Error	123.47	100.63	190.92	145.50	163.09	170.61
		R^2 (%)	81.83	3.74	49.28	80.07	89.98	78.63
		Initial Value	16.3	6.40	20.6	24.20	16.3	6.40
		End Value	19.5	20.82	24.2	39.90	24.2	39.90

3	Productivity (MT/Ha)							
		CAGR (%)	1.81*	12.52	1.47*	4.65	1.90	9.11
		Std. Error	0.53	10.75	1.33	4.80	1.02	8.81
		R^2 (%)	86.15	45.82	64.86	13.69	91.79	68.06

* Significant at percent 1

* *Significant at percent 5

Fig 2: Compound Annual Growth Rate of area, production, and yield of Tomato



Conclusion

.From the finding it was observed that, in period I area and production was positive at India level but in case of productivity recorded in Uttar Pradesh. In period II, the growth performance of area, production and productivity was better than the national level(India) and during overall period, India as well as Uttar Pradesh showing positive growth and Uttar Pradeshpercentage share of area, production and productivity was high than the India

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