

Estimation of Growth Rate in Area Production and Productivity of Watermelon in Jaipur District and Rajasthan State, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An attempt has been made in this paper to estimate the growth trends in area, production and productivity of watermelon in Jaipur district and Rajasthan state. For the present study, secondary data on area, production and productivity of watermelon in Jaipur district and Rajasthan state as a whole for the period of 8 years (2009-2010 to 2018-2019) were collected from Department of Horticulture, Pant Krishi Bhawan. The data were analyzed through growth rate, co-efficient of determination and root mean square techniques. For analysis of growth rates the exponential growth model was found the best model in this analysis. Growth rates in area, production and productivity of watermelon were estimated to be significantly negative in Jaipur district and the whole Rajasthan state for the study periods.

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1. INTRODUCTION

Watermelon (*Citrullus lanatus*) is the major commercial crop in India. It is one of the most important fruit cultivated in the tropics. In South Carolina, watermelon is called "Smile Fruit", but it is actually not a fruit. It is a vegetable like cucumber, squash, pumpkin and cantaloupe, the watermelon is really a member of the gourd family (i.e., Cucurbitaceae). Watermelon is a native of tropical Africa, it grown worldwide in tropical and subtropical areas for its large edible fruit. A large fruit is a kind of modified berry called a *pepo* with a thick rind (exocarp) and fleshy center (mesocarp and endocarp). The fruit is juicy, pink, red or yellow flesh with numerous small black seeds. The watermelon is an annual crop that has a prostrate or climbing habit. The watermelon fruit has 78 per cent edible portion. The edible portion in watermelon fruit contains moisture (95.8 per cent), protein (0.2 per cent), minerals (0.3 per cent), carbohydrates (3.3 per cent) and energy (16 k. cal) [1].

Watermelon has a global cultivation area of 32.41 million hectare with the production of 1039.31 million tonnes in the year 2018. India is among the major watermelon producing countries as well as China, Iran, Turkey, Brazil, United States, etc. China is ranked first in watermelon production in the world, with 628.03 million tonnes from an area of 14.99 million hectare in the year 2018(Source: India Agri Stat.com) [2-4].

Major watermelon growing states in India are Uttar Pradesh, Himachal Pradesh, Rajasthan, Orissa, Gujarat, Punjab, Haryana, Assam, West Bengal, Andhra Pradesh, Karnataka, Telangana and Maharashtra. In India, area under watermelon cultivation was estimated at 100 thousand hectares with production of 2495 thousand MT in the year 2018-19 (Source: Indian Horticultural Database, National Horticulture Board, 2018-19).

Rajasthan has a total of 2113 hectare as area under watermelon cultivation with production of 15120 million tonnes in the year 2018-2019. It is normally sown during end of February to mid of March annually. In the whole state, only Jaipur and Sikar districts have a large area under watermelon cultivation. During the year 2018-2019, Jaipur district occupied first position in area under watermelon cultivation with 1408 hectares with production of 3926 MT (Source:

Rajasthan agriculture statistics at a glance, Horticulture department, Jaipur, 2018-19) [5-7].

In Rajasthan, despite the presence of large area under watermelon cultivation, few farmers are practicing the watermelon farming, particular some regions provide on little area under watermelon crop at present. This is may be due to the lack of information on economic aspects like growth in production, costs and returns from cultivation of watermelon, marketing costs, margins and price spread in marketing of watermelon. Further, farmers do not know about the potential of watermelon for generating high income. Thus, vital information on the economic aspects of watermelon cultivation needs to be generated.

2. OBJECTIVE

1. The primary objective of this research is to analysed and estimate the growth rate in area, production and productivity of watermelon in Jaipur district and Rajasthan state.

3. METHODOLOGY

To estimate the growth rates in area, production and productivity of watermelon, the following growth models was tested:

Linear function:

$$Y = a_0 + a_1 X_1 + \dots + u_t$$

Where,

Y = Area / production / productivity of watermelon crop

a_0 = Constant

a_1 = Coefficient factor

X_1 = Production factor

u = Error term

t = time factor

Semi log function:

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

Where,

Y = Area / production / productivity of watermelon crop

α = Constant

β = Regression coefficient

t = time in year

Exponential function:

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

Taking log both side for linear transformation of functional model

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

$$Y^* = \alpha^* + \beta^*$$

Where,

$$Y^* = \log Y$$

$$\alpha^* = \log \alpha$$

$$\beta^* = \log \beta$$

Where,

Y = Area / production / productivity of watermelon crop

α = Constant

β = Regression coefficient

t = time in year

Compound growth rate (%) = (Antilog β -1)100.

After fitting the first linear trend function by least-square method, we get the estimate of β_1 . Then, annual linear growth rate was computed as follows

$$r = \frac{\beta_1}{\bar{y}} \times 100$$

Where,

\bar{Y} is arithmetic mean of Y_t

To obtain annual semi- log growth rate, it was computed as follows

$$r = \beta_1 \times 100$$

The annual Exponential growth rate was then computed as

$$r = (\text{Antilog } \beta_1 - 1)100$$

4. RESULTS AND DISCUSSION

4.1 Growth Rates in Area, Production and Productivity of Watermelon in Jaipur District

The growth rates in area, production and productivity of watermelon during the period (2009-2010 to 2018-2019) within 8 years, Jaipur

district are shown in table 1. The simple growth trends in area, production and productivity of watermelon in Jaipur district from above period are given in Figs.1, 2 and 3, respectively.

Table 1 shows that growth rate in area under the watermelon cultivation in Jaipur district decreased at an exponential growth rate of 2.34 per cent per annum which was significant at 1 per cent level of significance. Production of the watermelon was significantly decreased at exponential growth rate of 1.12 per cent per annum due to decreased in area under watermelon cultivation. The negative growth rate in productivity of watermelon was registered 2.11 per cent per annum at 5 per cent level of significance because of the decrease in area and production of watermelon in the study area. The coefficient of determination (R^2) was estimated to be 0.55, 0.57 and 0.49 indicated that 55 per cent, 57 per cent and 49 per cent of variation in area, production and productivity, respectively, was due to time variable. Similar study finding were reported by Acharya et.al. [8], Dakhare and Bhattachary [9].

4.2 Growth Rates in Area, Production and Productivity of Watermelon in Rajasthan State

Table 2 depicts that growth rates in area, production and productivity of watermelon in Rajasthan state as a whole for the period 2009-2010 to 2018-2019. The simple growth trends in area, production and productivity of watermelon in Rajasthan state during the study periods are given in Figs. 4,5 and 6, respectively.

This table indicates that growth rate in area under watermelon cultivation was decrease at 1.03 per cent per annum which was significant at 5 per cent level of significance. The growth rates in production and productivity of watermelon were found negative i.e., 1.43 and 10.13 per cent per annum, respectively. It was also found significant at 5 per cent level of significance. Watermelon cultivation recorded a negative growth rates in area, production and productivity during the study period in the state as whole. The coefficient of determination (R^2) for area, production and productivity of watermelon was 0.59, 0.53 and 0.52, respectively. It was also explained in term of 59 per cent, 53 per cent and 52 per cent of variation in area, production and productivity, respectively. Similar study was supported by Singh and Rani [10].

Table 1. Growth rates in area, production and productivity of watermelon during the period (2009-2010 to 2018-2019) in Jaipur district

s.no	Growth model	Response variable	Coefficients		Growth-rate (%per annum)	R ²	RMSE	F value
			β_0	β_1				
1.	Linear	Area	2304.06**	-79.28**	-4.24	0.52	242.72**	8.80**
	Semi-log		2233.48*	-241.97*	-2.41	0.28	297.23*	3.20*
	Exponential		2358.62**	-0.0451**	-2.34	0.55	0.1303**	10.02**
2.	Linear	Production	16793.06**	-1002.88**	-8.89	0.57	2793.27**	10.62**
	Semi-log		16082.86*	-3181.63*	-3.18	0.33	3472.64*	4.05*
	Exponential		20185.13**	-0.122**	-1.12	0.57	0.339**	10.62**
3.	Linear	Productivity	7791.53**	-351.62**	-6.0	0.48	1173.06*	7.41*
	Semi-log		7586.77**	-1144.81**	-1.14	0.29	1363.40**	3.41**
	Exponential		8557.68*	-0.077*	-2.11	0.49	0.2489*	7.85*

Figures in parentheses are level of significant
 ** Indicating significant at 1% level of significant.
 * Indicating significant at 5% level of significant.

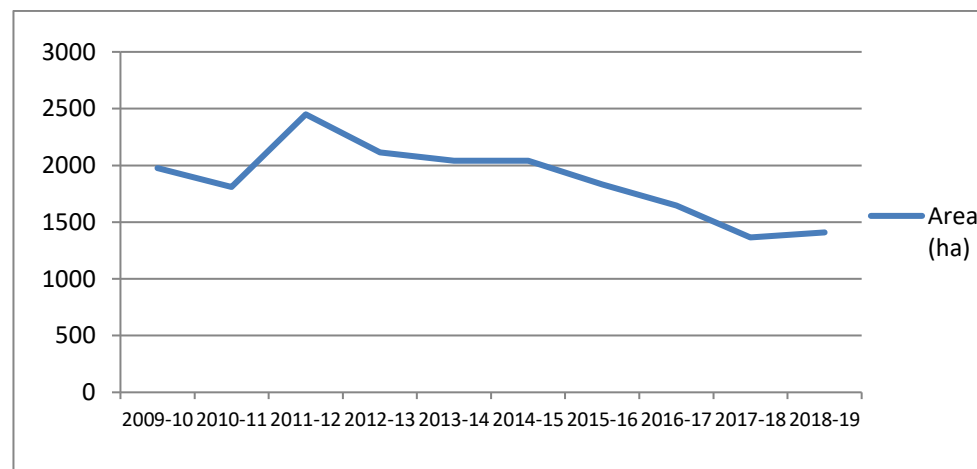


Fig. 1. Growth trend in area of watermelon in Jaipur district from (2009 –2010 to 2018 -2019)

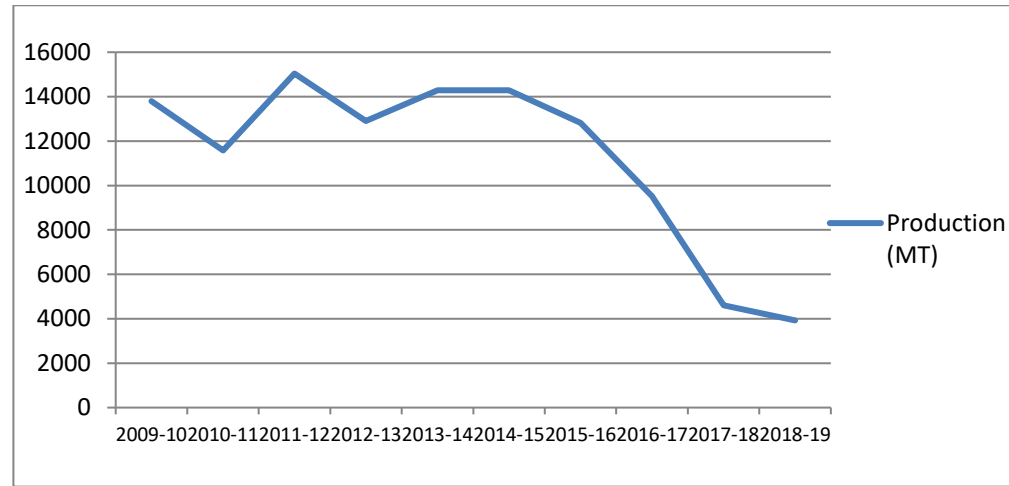


Fig. 2. Growth trend in production of watermelon in Jaipur district from (2009 – 2010 to 2018 - 2019)

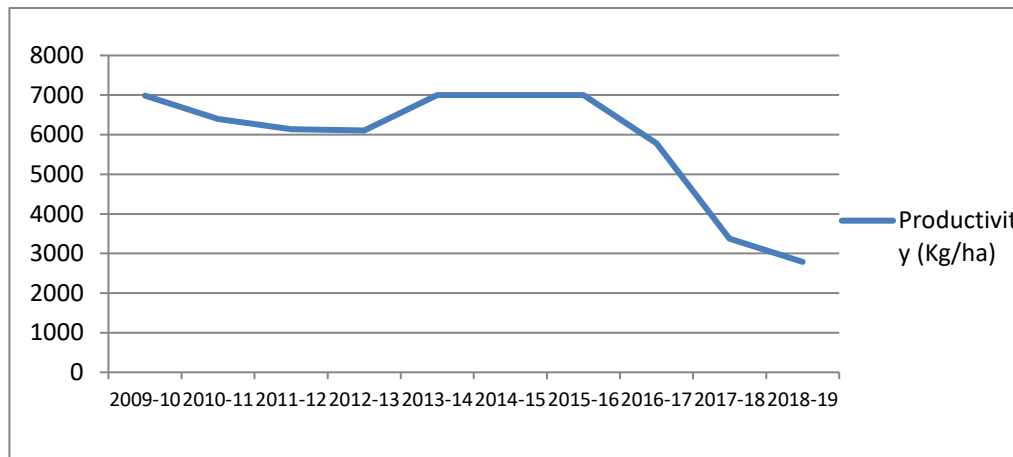


Fig. 3. Growth trend in productivity of watermelon in Jaipur district from (2009–2010 to 2018 - 2019)

Table 2. Growth rates in area, production and productivity of watermelon during (2009-2010 to 2018-2019) in Rajasthan state

s.no	Growth model	Response variable	Coefficients		Growth-rate (% per annum)	R ²	RMSE	F value
			β_0	β_1				
1.	Linear	Area 3MA	3257.16*	-97.891*	-3.60	0.59	215.98*	8.62*
	Semi-log		3149.78+	-251.30+	-2.51	0.32	299.98+	2.83+
	Exponential		3308.10*	-0.037*	-1.03	0.59	0.0836*	8.68*
2.	Linear	Production 3MA	16572.79*	736.56*	3.86	0.51	1907.74*	6.26*
	Semi-log		16435.83	2603.77	3.41	0.52	1877.17	6.66
	Exponential		16720.8*0	0.037*	-1.43	0.53	0.0894*	6.77*
3.	Linear	Productivity	5004.06*	389.84*	5.45	0.49	1253.75*	7.97*
	Semi-log		5007.56*	1417.22*	3.51	0.38	1387.45*	5.04*
	Exponential		5224.61**	0.053**	-10.13	0.52	0.1612**	8.76**

Figures in parentheses are level of significant

** Indicating significant at 1% level of significant.

* Indicating significant at 5% level of significant.

+ Indicating significant at 10% level of significant.

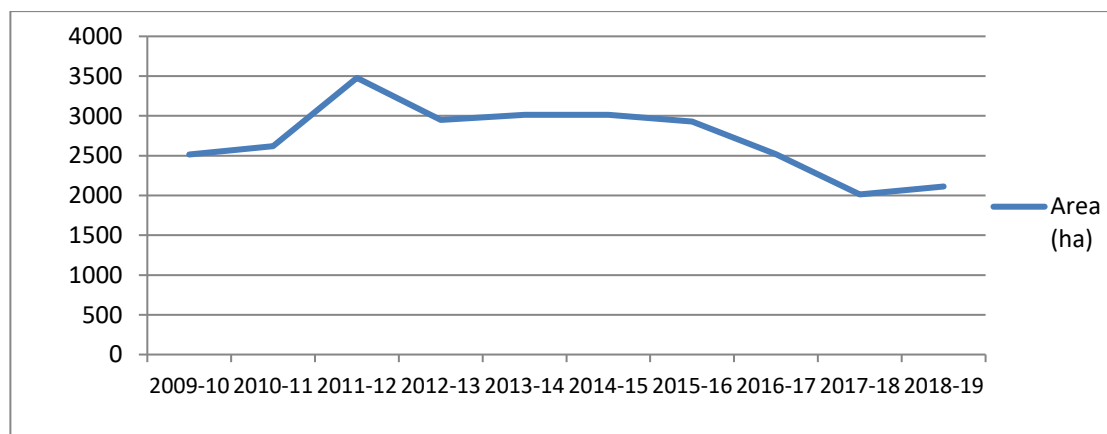


Fig. 4. Simple growth trend in area of watermelon in Rajasthan state from (2009–2010 to 2018-2019)

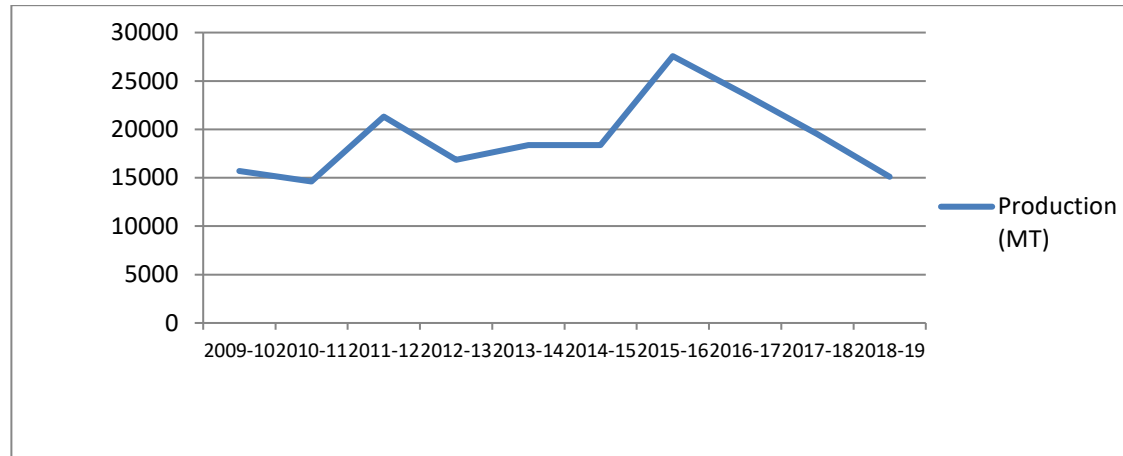


Fig. 5. Simple growth trend in production of watermelon in Rajasthan state from (2009 – 2010 to 2018 - 2019)

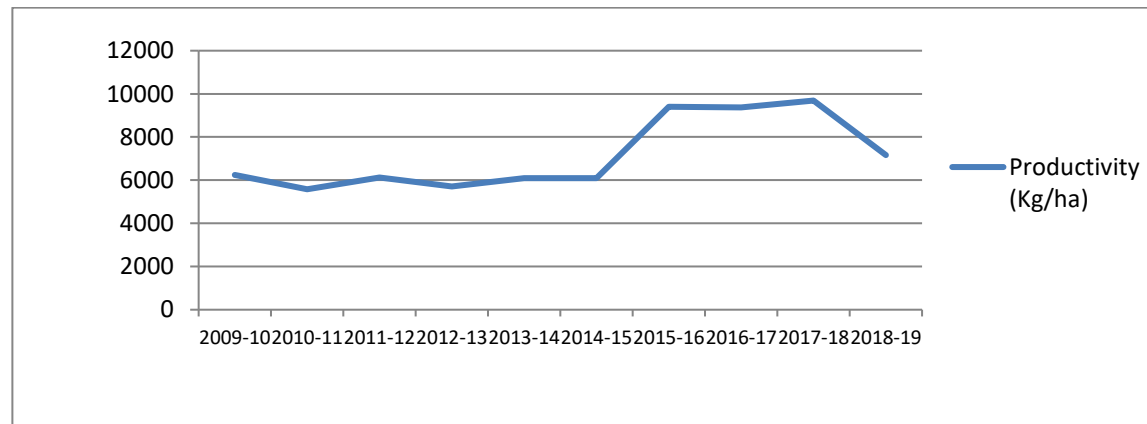


Fig. 6. Simple growth trend in productivity of watermelon in Rajasthan state from (2009 – 2010 to 2018 – 2019)

5. CONCLUSION

Based on eight year data it was concluded that the growth rates in area, production and productivity of watermelon were calculated and found to be significantly negative in the Jaipur district and in the Rajasthan state. Area, being a limited factor, cannot be increased without reducing the area under other substitute crops. Hence, there may be increase in the productivity of the crop by using developed varieties and new technology specially for changing agro-climatic conditions of the state. The study on cost structure of watermelon cultivation indicated that production of watermelon is profitable (i.e., 3.30 returns per rupee). So, this crop has a huge potential for increase in the farms income and employment opportunity. Therefore, government extension agencies as well as KVK of state agriculture universities may create awareness about profitability of watermelon cultivation among the farmers of the Rajasthan states and give the importance the acreage under watermelon in the cropping pattern at their farm.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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