Growth Rate in Area Production and Productivity of Watermelon in Jaipur district and Rajasthan state

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 2009-10 to 2018-19 were collected from Department of Horticulture, Pant KrishiBhawan etc. The data were analyzed through growth rate, co-efficient of determination and root mean square techniques to study the growth in area, production and productivity of watermelon in Jaipur district and Rajasthan state. Analysis of growth rates revealed that the exponential growth model was found best fitted model in this analysis. Growth rates in area, production and productivity of watermelon were estimated to be significantly negative in Jaipur district and in Rajasthan state for the study period 2009-10 to 2018-19.

Introduction:

Watermelon (*Citrulluslanatus*) 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. Watermelon is 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).

Global area under watermelon cultivation was 32.41 million hectare with the production of 1039.31 million tonnes in the year 2018. Major watermelon producing countries

are China, Iran, Turkey, Brazil, United States, India etc. in the world. China ranked first in watermelon production with 628.03 million tonnes from an area of 14.99 million hectare in the year 2018(Source: India Agri Stat.com).

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).

In Rajasthan, area under watermelon cultivation was 2113 hectares with production of 15120 MT in the year 2018-19. It is sown during late February to mid-March in Rajasthan state. In this state, large area was put under watermelon crop in only Jaipur and Sikar districts and in remaining districts, area under watermelon crop. Jaipur district occupied first position in area under watermelon cultivation with1408 hectares with production of 3926 MT during the year 2018-19 (Source: Rajasthan agriculture statistics at a glance, Horticulture department, Jaipur, 2018-19).

In Rajasthan, few cultivators practice in particular regions as well as on little area put under watermelon crop at present. This is mainly due to the lack of the information on economic aspects like growth in production, costs of and returns from cultivation of watermelon, marketing costs, margins and price spread in marketing of watermelon. Further, cultivators 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.Determining the growth rate in watermelon cultivation is crucial for various stakeholders, including farmers, government agencies, and researchers, because it provides valuable information for decision-making and optimizing the cultivation process. Here's why growth rate is important for farmer by taking the growth rate, farmers can estimate the expected yield from their crop, which is crucial for planning sales and distribution. Government agencies are responsible for agriculture growth rate data to develop and implement policies that support the farming industry. This might include subsidies, regulations, research funding based on the performance of different crops and research

usegrowth rate data to develop new watermelon varieties with growth improved characteristics, disease resistance, or batter adaptation to specific environmental conditions.

In summary, determining the growth rate in watermelon cultivation is essential because it directly impacts the profitability and sustainability of farming operations. It allows farmers to make informed decisions, helps governments support the agricultural sector, and enables researchers to enhance crop quality and resilience. This information is critical for ensuring a stable and efficient supply of watermelons for consumers while minimizing the environmental impact of farming.

Objective:

1. Growth rate in area, production and productivity of watermelon in Jaipur district and Rajasthan state.

Methodology:

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

Linear function:

$$\mathbf{Y = a_0 + a_1 x_1 + \ldots + u_t}$$

Where,

Y = Area / production / productivity of watermelon crop

a_0 = Constant

a_1 =Coefficient factor

x_1= Production factor

u = Error term

t_1 = time factor

Semi log function:

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

Where,

Y = Area / production / productivity of watermelon crop

α= Constant

β= Regression coefficient

t= time in year

Exponential function:

$$\mathbf{Y= \alpha \beta^{t}}$$

Taking log both side for linear transformation of functional model

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

$$\mathbf{Y^{*} = \alpha^{*} + \beta^{*}}$$

Where,

$\mathbf{Y^{*} = log\ Y}$

$\mathbf{\alpha^{*} = log\ \alpha}$

$\mathbf{\beta^{*} = log\ \beta}$

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 annul semi- log growth rate, it was computed as follows

$$r = \beta_1 X\ 100$$

The annual Exponential growth rate was then computed as

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

Results and Discussion:

Growth rates in area, production and productivity of watermelon in Jaipur district

Year	Area	Production	Productivity
2009-10	2514	15692	6241
2010-11	2619	14615	5580
2011-12	3478	21309	6127
2012-13	2951	16844	5708
2013-14	3013	18379	6100
2014-15	3013	18379	6100
2015-16	2929	27564	9408
2016-17	2518	23607	9374
2017-18	2013	19504	9689
2018-19	2113	15120	7155

Source:- Ministry of Agriculture and Irrigation , All India Report on Agriculture Census :1970-71

The growth rates in area, production and productivity of watermelon during the period 2009-10 to 2018-19 in Jaipur district are shown in table no.1 The simple growth trends in area, production and productivity of watermelon in Jaipur district from 2009-10 to 2018-19 are given in Fig.No.1, 2 and 3, respectively.

Table No. 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.* (2012), Dakhare and Bhattchary (2013).(The growth in area, production and productivity of different crops in Karnataka was estimated using the compound growth function. The necessary secondary data were collected for a periodof 26 years from 1982-83 to 2007-08. The results of the study showed that growth in area under pulses, vegetables. Spices, fruits and nuts was significant and positives while it was significant and negative in cereals. The production of oilseeds and commercial crops registered insignificant positive growth, the growth in productivity was insignificant and negative.).

Figure no-1Combined the growth trend in area, production and productivity of watermelon from 2009-10 to 2018-19

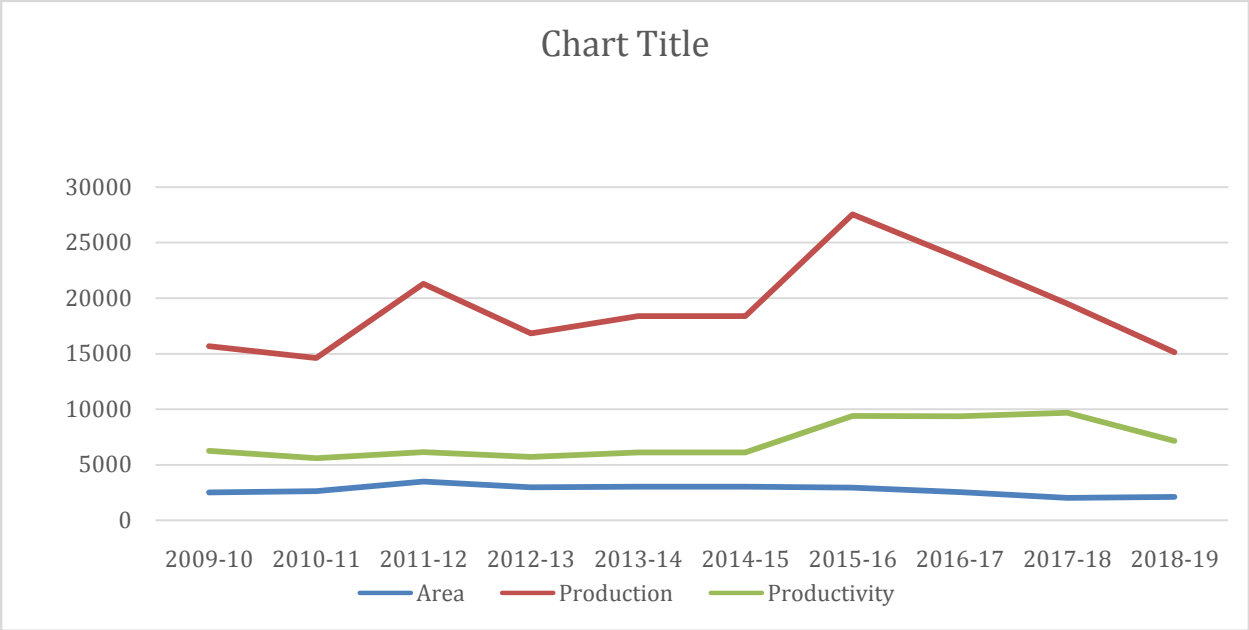

Table No. 1Growth rates in area, production and productivity of watermelon during the period 2009-10 to 2018-19 in Jaipur district.

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.

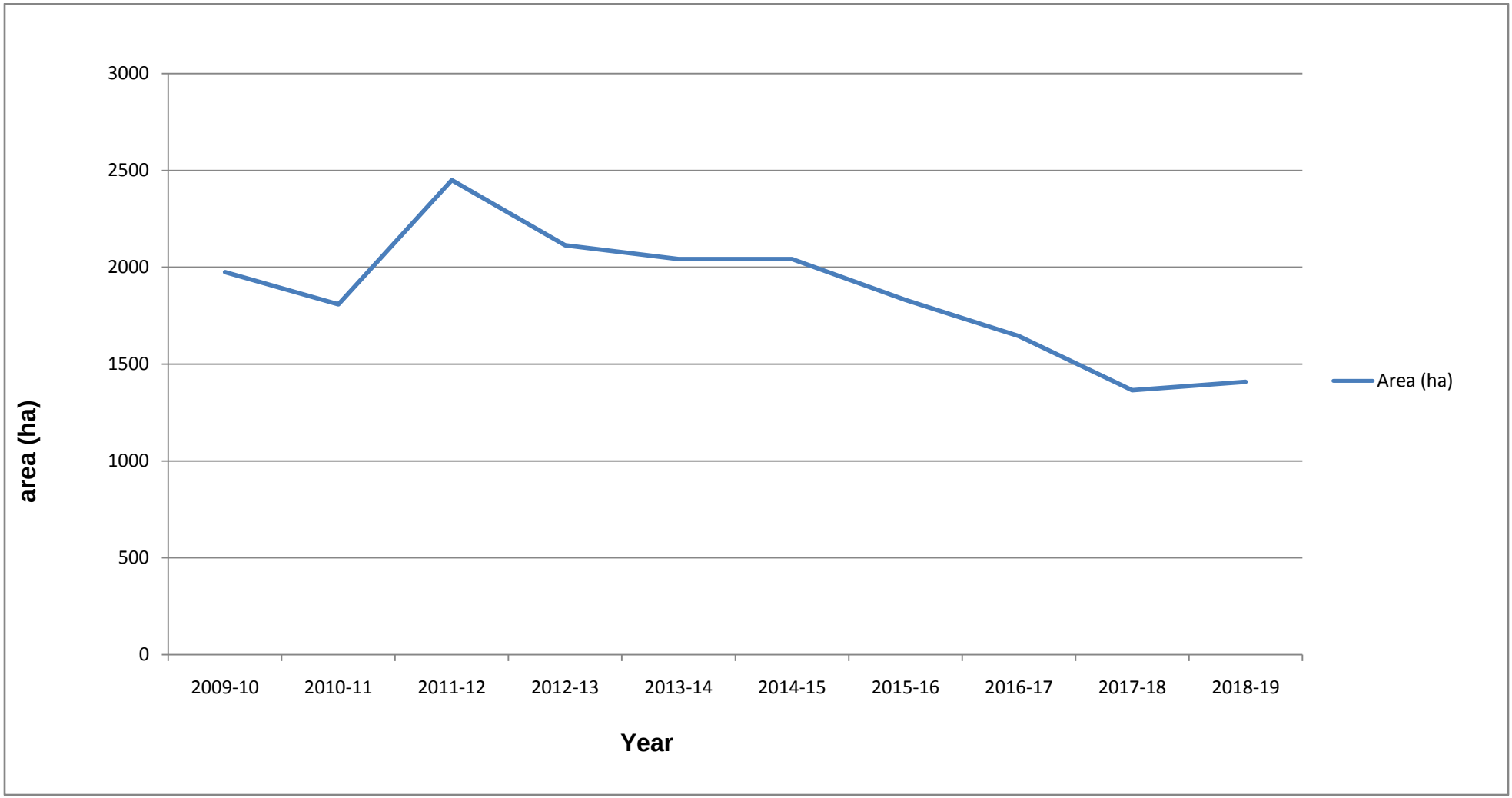

Fig.No.2 Simple growth trend in area of watermelon in Jaipur district from 2009 – 10 to 2018 - 19

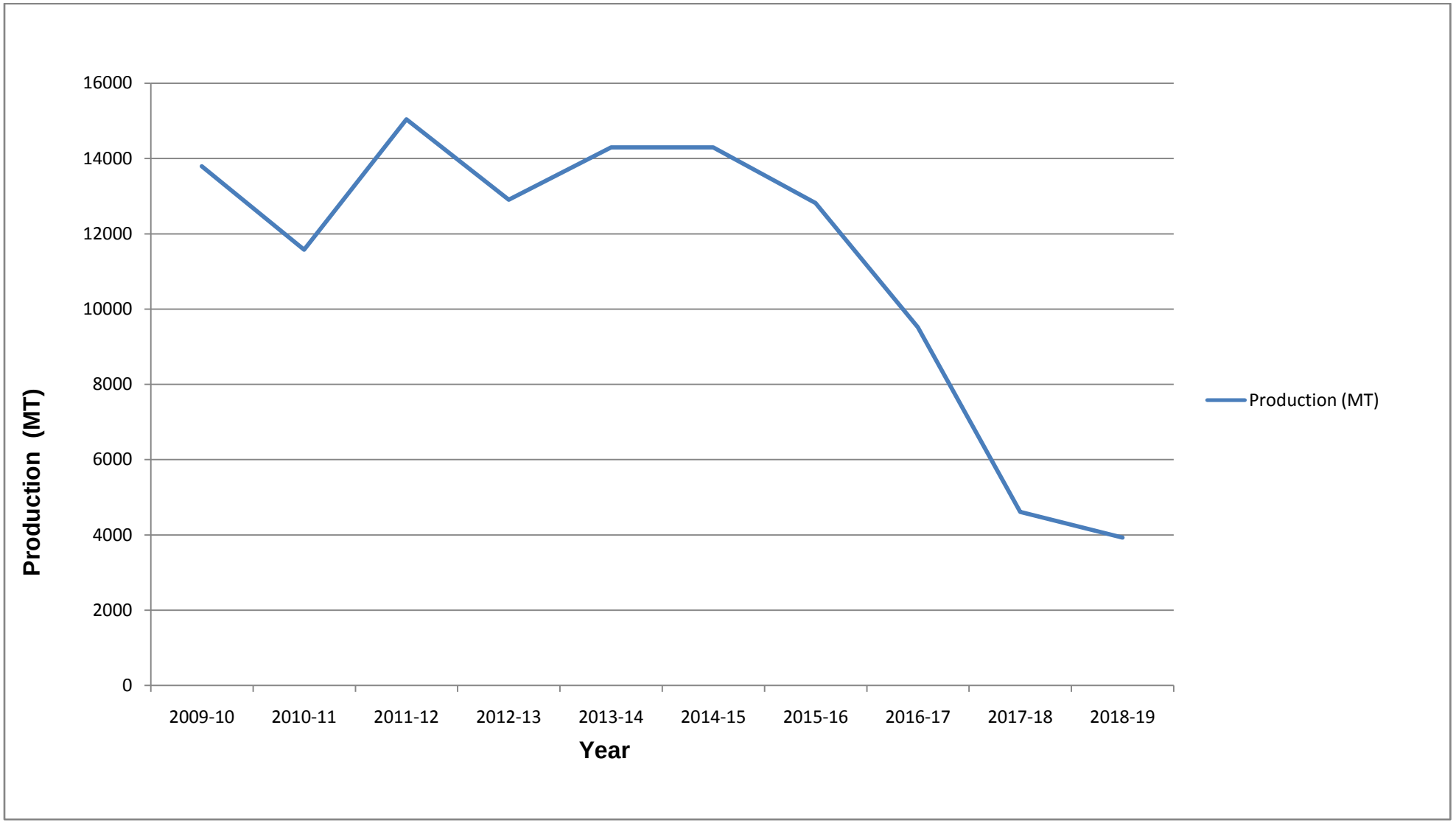

Fig.No.3 Simple growth trend in production of watermelon in Jaipur district from 2009 – 10 to 2018 - 19

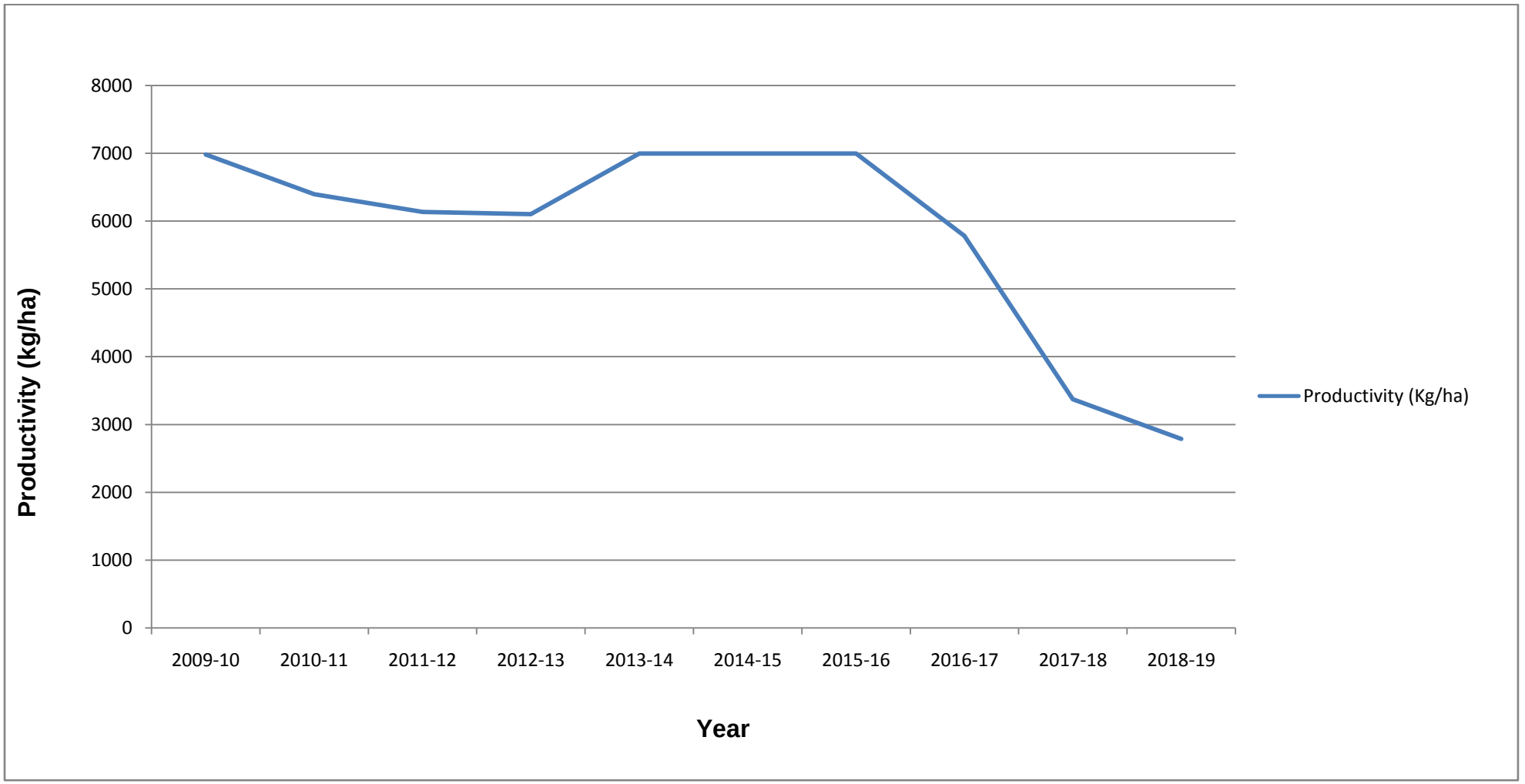

Fig.No. 4 Simple growth trend in productivity of watermelon in Jaipur district from 2009 – 10 to 2018 - 19

Growth rates in area, production and productivity of watermelon in Rajasthan state

Table No.2 depicts that growth rates in area, production and productivity of watermelon in Rajasthan state as a whole for the period 2009-10 to 2018-19. The simple growth trends in area, production and productivity of watermelon in Rajasthan state during the study periods are given in Fig.No.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 (2013) (The study revealed that growth rate in all selected fruits (litchi, mango, guava and banana) except citrus was positive. It was observed that, IV period (2005-10) was found to be favorable for litchi, mango, and guava particularly, while negative growth rate was found in banana and citrus).

It could be concluded the results from the analysis presented in this section that there has been found negative trend in growth of production of watermelon in Jaipur district and Rajasthan state as a whole during the study period. This decline in production was contributed by also decrease in area and productivity of watermelon. This clearly brings that the existing practice adopted by watermelon cultivators has not been able to sustain the existing level of productivity of watermelon in the study area.

Table No. 2 Growth rates in area, production and productivity of watermelon during 2009-10 to 2018-19 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.

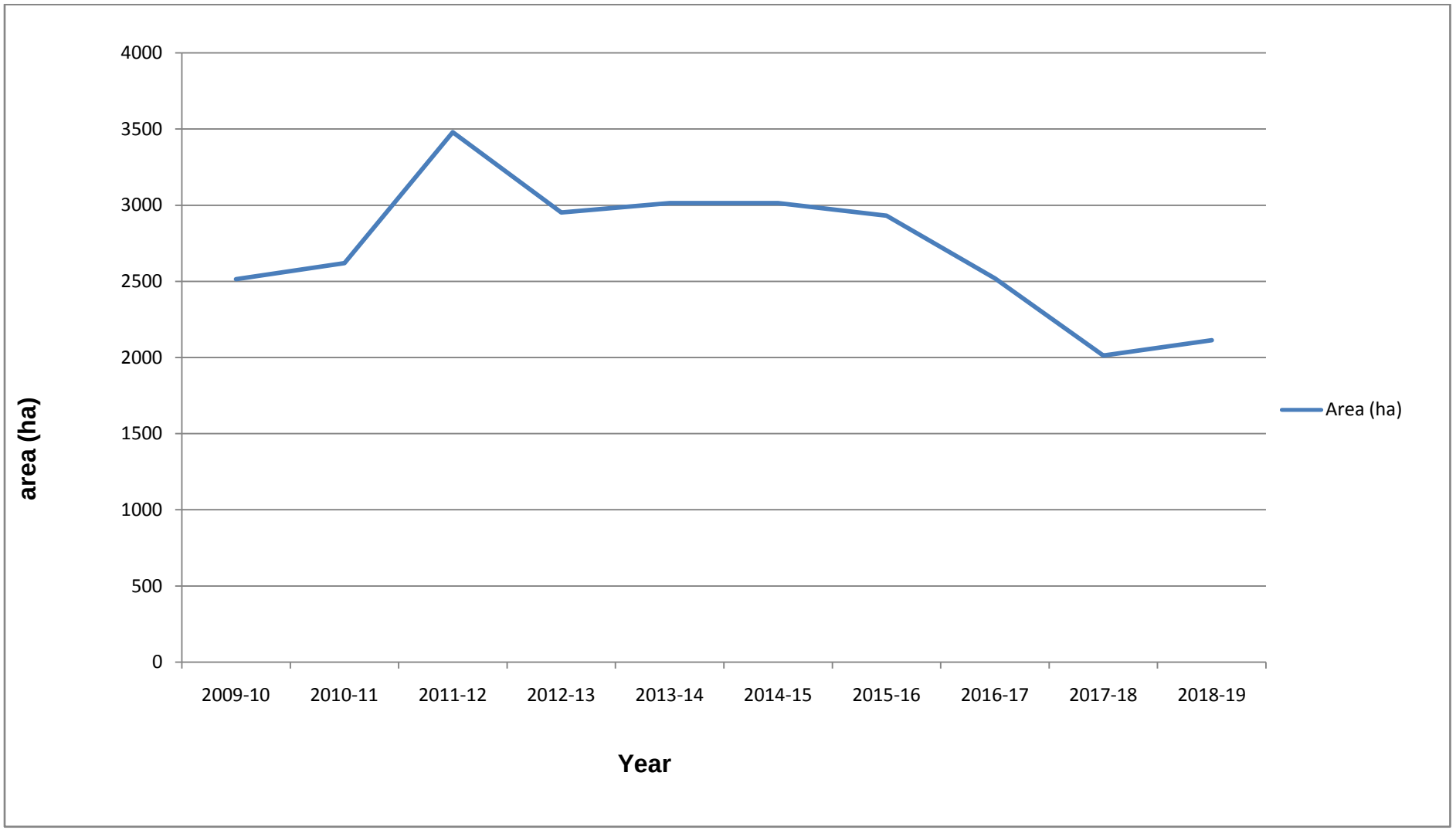

Fig.No. 5 Simple growth trend in area of watermelon in Rajasthan state from 2009–10 to 2018-19

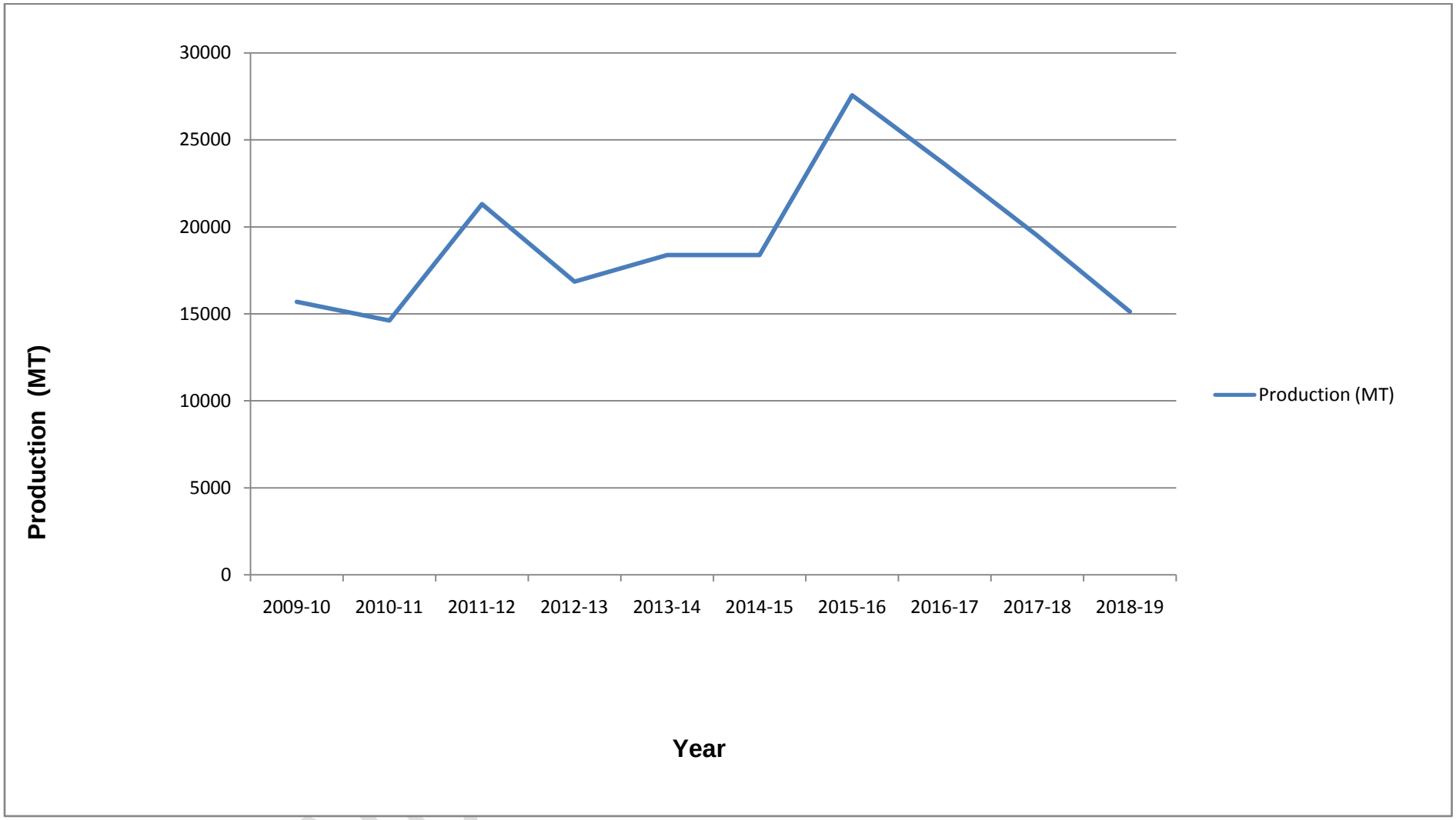

Fig.No.6 Simple growth trend in production of watermelon in Rajasthan state from 2009 – 10 to 2018 - 19

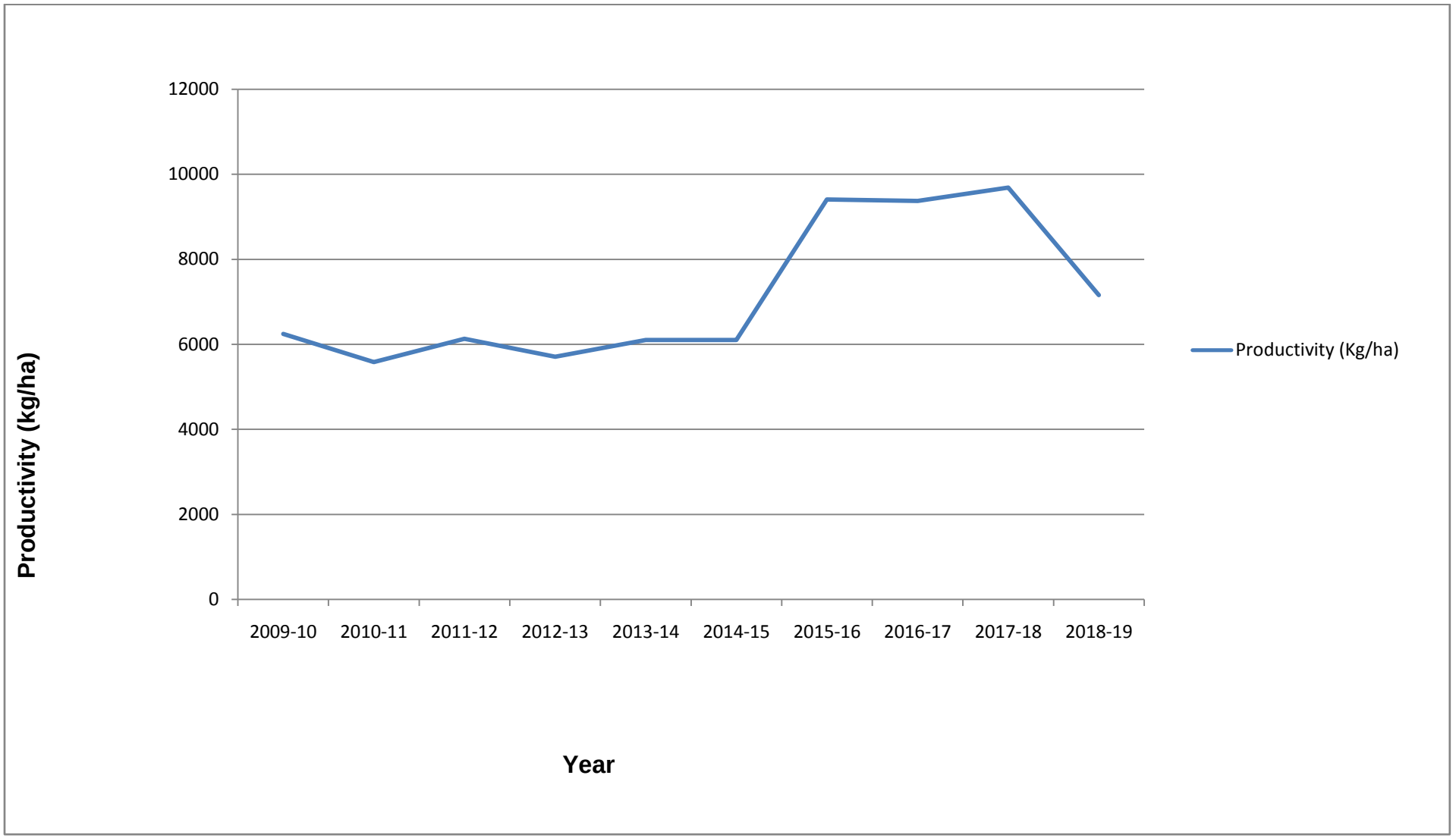

Fig.No.7 Simple growth trend in productivity of watermelon in Rajasthan state from 2009 – 10 to 2018 – 19

Conclusion:

The growth rates in area, production and productivity of watermelon were calculated significantly negative in the Jaipur district and in the Rajasthan state.

References:

Acharya, PoudelSaraswati, H. Basavaraja, L.B. Kunnal, S.B. Mahajanasetti and A.R.S. Bhat (2012). Growth in area, production and productivity of major crops in Karnataka. *JournalAgricultural Science*, **25**(4) : 431-436.

Dakhare, D.S. and D. Bhattcharya (2013).Growth and instability of area production and productivity of vegetables in west Bengal, India. *International Journal of Bio Resource and Stress Management*, **43**(4).

Singh, R.P. and Nimmy Rani (2013). To study growth rate of area, production and productivity of fruit crops in Jharkhand. *Journal of Economic & Social Development*, **9**(1).