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Trends and Exports of Garlic in India

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Authors' contributions

This work was carried out in collaboration between both authors. Author GP designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author SSK managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: The present study entitled "Trends and exports of garlic in India" was undertaken to know trend in area, production, productivity, export quantity, domestic and international prices and competitiveness of Indian garlic export in international markets.
Study Design: Secondary data regarding area, production, productivity, export quantity, export value, domestic and international prices of garlic in India was collected from 1990-91 to 2019-20, which includes 30 years data. The period has been divided in to three periods i.e., period I (1990-91 to 2004-05), period II (2005-06 to 2019-20) and overall period (1990-91 to 2019-20).
Place and Duration of Study: The information of the present study was obtained from secondary data. Data was pertained from the year 1990-91 to 2019-20.
Methodology: Different functions were tried to study trend in area, production, productivity, export, domestic and international prices of garlic and the best fit was used to analyse the trend. The export competitiveness of garlic was measured by Nominal Protection Coefficient.
Results: Area, production, productivity, export quantity, export value of garlic showed cubic trend indicating that the movement of all the series was uniform throughout India whereas unit value of

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export, domestic and international prices of garlic showed compound trend. The export competitiveness of garlic was measured by Nominal Protection Coefficient which concluded values for period I was 1.70, for period II was 1.60 and for overall period was 1.65 indicating non-competitiveness of Indian garlic in all the periods in international markets.

Conclusion: The study was mostly based only on a secondary data collected from various published sources. Limitations inherent in the secondary data are inevitable. It is important to increase export share of garlic by taking appropriate efforts. Market support by Government is necessary to support the farmers from considerable fluctuation in price and motivating them to produce a quality garlic.

Keywords: Export competitiveness; garlic; nominal protection co-efficient'; trend analysis.

1. INTRODUCTION

"Garlic is a hardy, bulbous, rooted, perennial plant with narrow flat leaves and bears small white flowers and bulbils. The compound bulb consists of 6 to 34 bulblets called 'cloves' which are surrounded by a common thin, white or pinkish papery sheet. Garlic has a strong flavour and taste. It is a native of West Asia and Mediterranean area. China, Korea, India, USA, Spain, Argentina and Egypt are the major garlic growing countries. As per 2019-2020 data, India occupies 13th place in export of garlic contributing 0.31 per cent share in world trade. Major importing countries of Indian garlic fresh/chilled have been USA, Bangladesh, Malaysia, United Arab Emirates, Taiwan, Nepal, Oman, Djibouti, Thailand, Vietnam. China is the largest exporter of garlic in the world and its share in world trade is around 70-80 per cent" (agriexchange.apeda.gov.in). The production and productivity of garlic in India are very low compared to many other countries with total area of 3,62,950 hectares and total production of 29,16,970 tonnes. Madhya Pradesh is in the top position in garlic production with total produce of 18,49,470 tonnes. The total contribution by Madhya Pradesh in garlic production to India has been 63.4 per cent. Maharashtra occupies 10th place contributing the share of 0.47 per cent in garlic production in India with production of 13,880 tonnes (India stat). Unawareness of farmers about improved varieties, climate, soil and agro-techniques, diseases and pest damaging the crops and their control measures as well as post-harvest management are though main reasons, inadequate market support is also responsible for limiting the production and productivity indirectly (agriexchange.apeda.gov.in). "Trends and exports of garlic in India" was undertaken to know trend in area, production, productivity, export quantity, domestic and international prices and competitiveness of Indian garlic export in international markets.

2. MATERIALS AND METHODS

a) Trend Analysis

Trend analysis in area, production, productivity, export quantity, export value, unit value of export, domestic and international prices of garlic for the overall period 1990-91 to 2019-20 was carried out. Different functions were tried and the best fit (measured in terms of R^2) was selected to interpret result.

Table 1. Different parametric models with their equations

Sr. No.	Function	Equation
1	Linear	$Y_t = a + b_t$
2	Logarithmic	$\text{Log } Y_t = \text{Log } a + \text{Log } b_t$
3	Inverse	$Y=f(x)$; $Y= f^{-1}(f(x))$
4	Quadratic	$Y_t = a+b_t+c_t^2$
5	Cubic	$Y_t = a+b_t+c_t^2+d_t^3$
6	Compound	$Y =b_0*(x^{b}1)$
7	Power	$Y = b_0*(b_1^x)$
8	Square root	$Y = a +b*\sqrt{x}$
9	Growth	$Y_t = a+bc$
10	Exponential	$\text{Log } Y =b_0+b_1x$
11	Logistic	$Y =K/1+\exp(a+b*x)$

Where, Y = area/ production/ export quantity/ export value and x = time

b) Nominal Protection Coefficient

The Nominal Protection Coefficient was calculated to estimate the extent of the commodity's competitive advantage in the context of free trade. In a free trade situation, the coefficient revealed if a country has a comparative advantage in the export of that commodity. The ratio of the domestic price to the world reference price of the commodity under consideration is known as the NPC. Symbolically,

$$NPC = P_d/P_r$$

Where, P_d = Domestic price of the commodity
P_r = World reference price of the commodity

If NPC > 1, the commodity is protected, compared to the situation that would prevail under free trade and if NPC < 1, the commodity is not protected [1].

3. REVIEW OF LITERATURE

3.1 Trend in Domestic and International Prices

Singh and Rani [2] conducted "a study on growth rate of area, production and productivity of fruit crops in Jharkhand. The study was conducted during the period 1990-2010. The study period was divided in to five sub periods. Positive growth rate was observed in all selected fruits (litchi, mango, guava and banana) except citrus. It has also been observed that among periods, 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. The productivity growth rate was also observed to be positive for the selected fruits. This trend resulted in positive growth in volume of these fruits in the state".

Shukla et al. [3] Conducted "a study on the trends in area, production and productivity of onion crop in different agro-economic regions of Uttar Pradesh for the period 1995-96 to 2009-10. It was observed that the overall growth rate in area and production of onion in the state was of decreasing trend. The overall growth rate in productivity of onion was observed increasing trend".

Deepak et al. [4] conducted "a study on analysis of trend in area, production and yield of major vegetables of Nepal. It was observed that solanaceous and cruciferous vegetables has an increasing trend in area, production and yield except for the area under cultivation of egg plant and radish. It has also been observed that cucurbitaceous vegetables has increasing trend in area and production except for the yield of cucumber. The trend of other major vegetables is seen highly fluctuating over the years".

Gayathri [5] conducted "a study on a trend analysis of area, production, and yield of groundnut in India. The study was during the period 2000-01 to 2015-16. It was observed that production and yield shows an increasing trend. The compound growth rate of the area of groundnut is showing the negative trend. The compound growth rate of the area, production, and yield of groundnut of major producing states in India reveal that except Madhya Pradesh and Rajasthan all other states are showing a negative trend. Regarding the Production of groundnut, the states like Gujarat, Madhya Pradesh, Rajasthan and Uttar Pradesh shows a positive trend. While considering the yield of groundnut Gujarat, Maharashtra and Tamil Nadu showed positive trend during the period".

Avinash and Patil [6] conducted "a study on trends in area, production and productivity of major pulses in Karnataka and India: An economic analysis. The study was conducted during the period 1980 to 2016. It was observed that growth in area, production and productivity were positive in all the period except productivity in period-I. The country as a whole showed positive growth in area, production and productivity and significant during the period".

Sachin et al. [7] conducted "a study to find out the growth and trends of area, production and yield of garlic in Haryana during the period 1990-91 to 2016-17. The area and production growth trends in Haryana was positive while in yield growth trend was negative. Area, production and productivity trends in case of India are positive".

Rahman and Bee [8] conducted "a study on trends and pattern of sugarcane production in Shahjahanpur District, Uttar Pradesh: A Geographical Analysis. The study was to assess the trends and patterns of sugarcane

production in the district and explain the reasons behind the changes in the sugarcane production. The study is based on secondary sources of data. The study reveals that there is uneven trend of area under sugarcane as well as production of sugarcane in the district".

Sekhara [9] conducted "a study on Trends in Area, Production and Productivity of Paddy Crop: an Overview. The study was during the period 1991 – 2016. The studies showed that the paddy production in India for the last 65 years (1950-51 to 2014-15) achieved an abnormal growth in terms quantity of production comparative to the past and post-independent period and made India not only self-sufficient in Paddy production but also the big exporter of paddy in the world. But, the production of paddy exhibited a fluctuating trend in the past few decades i.e. especially in this study period (1991-92 to 2015- 16) in the both global and in Indian scenario".

Nain et al. [10] conducted "a study on instability and trend in area, production and productivity of rice crop in Haryana and India. The study was during the period 1966-2013 which was divided in to five sub periods. It was observed that area, production and yield of rice crop have shown positive growth rates in Haryana during entire period except for the yield in sub period-V. It was also found that Haryana has similar overall trend of India in production of rice crop. Yield has shown positive growth rates during entire study period whereas negative growth rates were observed in area during sub period IV and V".

Bhat [11] conducted "a study on trends and growth in area, production and productivity of apples in India from 2001-02 to 2017-18. It was observed that the area under apples has increased and there has been a rising trend in the area under apples in India except 2002-03. It was also found that the rising trends has been observed in production and Productivity of apples in India during the study period".

3.2 Export Competitiveness

Shivaraya and Hugar [12] conducted a study on export growth and competitiveness of vegetables in the context of wto - a case study of tomato. The study was based on the data for a period of 20 years from 1979-80 to 1998-99. The values of nominal protection coefficients (NPC) in tomato were worked out to be less than unity (0.60) over a period of 11 years indicating highly competitiveness of tomato for export in international market. NPC values over the years showed a decreasing trend from 0.66 in 1988-89 to 0.47 in 1998-99 clearly indicating increasing profitability for export of this vegetable during recent years. The NPC's of less than 0.67 for fresh tomatoes during all the years from 1988-89 to 1998-99 indicated highly export competitiveness of tomato.

Mendhe and Degaonkar [13] conducted a study on export performance of Indian chilli. Detailed analyses of export trade of this chilli have been studied. The average NPC for oleoresins of different countries were less than 1.00, hence, export of oleoresins of chilli was moderately competitive in countries. The average NPC of chilli powder for different countries were also less than 1.00, hence, export of chilli powder was moderately competitive in these countries. The average NPC of dry chilli for different countries were also less than 1.00, hence, export of dry chilli is moderately competitive.

Banakar et al. [14] conducted a study on export competitiveness of sugarcane jaggery in Karnataka -a comparative analysis. It was observed that Nominal Protection Coefficient was found to be less than unity (0.57), which implies that jaggery is good exportable product, hence there is competitive advantage for export of jaggery from India.

Rajur and Patil [15] conducted a study on export performance of chilli – An analysis. The study was conducted to examine the export competitiveness. In chilli, the nominal protection coefficient was less than one ranging from 0.32 in 1996-97 to 0.62 in 2004-05 indicating its high export competitiveness.

Darekar [16] studied Performance and Competitiveness of Onion Export from India. The study was based on time-series data from pre-WTO (1987-1995) to post-WTO (1996-2013). The calculations of NPC have shown that onion had a competitive disadvantage in pre-WTO period because the values of NPC have been found more than one. More than unity value of NPC in pre-WTO

period revealed that the domestic price of onion was more than the import price, which signified that the onion received protection from the country. During post-WTO period, the competitiveness of onion improved significantly as supported by estimates of NPC and which turn out to be less than one.

Pal et al. [17] conducted a study on Export Opportunities And Competitiveness of Vegetable Crops in Gujarat. The study was based on the data collected for the period 2010-2011 in Gujarat. The study clearly shows that the export of all the different vegetables was found to be moderately competitive. Out of four vegetable crops, cabbage was found most competitive with the lowest (NPC) Nominal Protection Coefficient (0.539), followed by potato (0.712), tomato (0.786) and onion (0.843). The country wise NPC (Nominal Protection Coefficient) for cabbage export from Gujarat during the year 2011 indicates that export of cabbage was highest competitive to Singapore with the lowest NPC of (0.226), followed by UAE (0.392). It was moderately competitive to the Maldives (0.706) whereas, it was found non competitive in case of Nepal (1.796).

Karthick et al. [18] conducted a study on growth and export performance of ginger in India- An economic analysis. To assess the export competitiveness of ginger NPC was worked out for the years 2004-05 to 2008-09. It was observed that NPC was more than one for the period 2004-05 to 2008-09 indicating non-profitable of export of ginger.

Hazari and Kanti De [19] conducted a study to examine the export performance of selected vegetables and spices in India. Among the vegetables Brinjal, Tomato and onion and from the spices Black pepper, coriander, cumin and chilli were selected for the present investigation. Average NPC indicated that selected vegetables and spices have NPC less than one indicating export competitiveness of these crops.

Jagatap et al. [20] conducted a study on export performance of onion. The study was based on the data collected for the period 1990-91 to 2009-10.divided into two sub periods (i. e.1990-91 to 1999-2000 and 2000-01 to 2009-10). The nominal protection coefficient ranges from 0.33 % to 0.90%. The NPC (Nominal Protection Coefficient) highest in 2009 (0.90%) and lowest in 2002 and 2005 (0.33%). NPC (Nominal Protection Coefficient) for onion under exportable hypothesis remained below one throughout the study period. The average NPC (Nominal Protection Coefficient) for onion was less than (0.57) means the crop was export competitive. This indicates that there was wide scope for increasing the export onion.

Kshirsagar et al. (2019) [21] conducted a study on export competitiveness in spices from India. The study reveals that nominal protection coefficients has indicated that chilli and coriander were competitive for exports to several countries. The black pepper, turmeric and cumin were moderately competitive for exports to all the continents.

Wasnik et al. [22] conducted a study on an analysis of trend and export competitiveness of tobacco in India. This paper studied the trend of tobacco export in domestic and international prices and export competitiveness during the period 1987-88 to 2016-17. The NPC value of tobacco showed the average value as 0.40 per cent and 0.46 per cent in period I and period II, respectively and the NPC value for overall period was 0.43 per cent. It indicates highly competitiveness in international market. Result shows that the export of tobacco from India is highly competitive.

4. RESULTS AND DISCUSSION

a) Trend analysis:

The trend equations were fitted to assess the trend in area, production, productivity, export quantity, export value, unit value of export, domestic and international prices of garlic. Depending upon its better fit, the trend and the results are assessed. The assessed results are presented under different categories namely trends in in area, production, productivity, export quantity, export value, unit value of export, domestic and international prices in Table 2.

Knowing the overall performance of area, production, productivity, export quantity, export value, unit value of export, domestic and international prices of garlic, path of movement of the series was traced through parametric trends model (Table1). A wide range of models are explored, among the competitive models the best fitted models are selected based on the R^2

along with significance of coefficients b1, b2, and b3, in which b1 represents effect of time on Y (area, production, productivity, export quantity, value and unit value of export in period I, b2 represents effect of time on Y (area, production, productivity, export quantity, value and unit value of export in period II, b2 represents effect of time on Y (area, production, productivity, export quantity, value and unit value of export in period III. Negative co-efficients (b1,b2, b3) indicate inverse relationship between X (time) and Y (variables like area, production, productivity, export quantity, value and unit value of export.

R^2 value in trend analysis of garlic area varies from 0.21 to 0.97, where maximum R^2 value is 0.97, observed in quadratic and cubic trend but cubic trend was considered as best fit based on high b_1 value. Interms of production trend analysis of garlic, R^2 value varies from 0.17 to 0.93 in which 0.93 was the maximum R^2 value in the cubic trend considered as best fit. Trend analysis of productivity showed R^2 value varying from 0.19 to 0.74, in which 0.74 was the maximum R^2 value in the cubic trend suited for best fit. Trend analysis of Export quantity showed R^2 value varying from 0.01 to 0.41 in which 0.41 was the maximum R^2 value in the cubic trend suited for best fit. Export value showed R^2 value varying from 0.10 to 0.61, in which 0.61 was the maximum R^2 value observed in the cubic trend considered as best fit. Unit value of export showed R^2 value varying from 0.21 to 0.86, in which 0.86 was the maximum R^2 value observed in the compound, growth, exponential and logistic trend, in which compound trend considered as best fit based on high b_1 value. Domestic prices showed R2 value varying from 0.17 to 0.75 in which maximum R^2 value was observed in compound, growth, exponential and logistic trend but compound trend was considered as best fit based on high b_1 value. International prices showed R^2 value varying from 0.21 to 0.84 in which maximum R^2 value was observed in compound, growth, exponential and logistic trend but compound trend was considered as best fit based on high b_1 value. With variables such as area, production, productivity, export quantity, value and unit value of export on Y axis and years on X axis, presented graphs below Table.2.

Among the competitive parametric models, cubic models are found to be best fit for area, production, productivity, export quantity and export value indicating that the movement of all the series except for unit value of export, domestic prices and international prices was uniform throughout the India.

Table 2. Trend in area, production, productivity, export, domestic and international prices of garlic (1990-2020)

Sr.No.	Particulars	Function	R2	Coefficients		
				b1	b2	b3
1	Area	Cubic	0.97**	-1.834	0.301	0.002
2	Production	Cubic	0.93**	67.543	-5.704	0.207
3	Productivity	Cubic	0.74**	0.217	-0.016	0.000
4	Export Quantity	Cubic	0.41*	-3687829.427	328145.207	-6763.059
5	Export Value	Cubic	0.61**	-83014881.100	6966774.105	-117285.129
6	Unit Value of Export	Compound	0.86**	1.073		
7	Domestic price	Compound	0.75**	1.056		
8	International price	Compound	0.84**	1.069		

*Note: **, * - denotes significant at 1 % and 5 % level respectively, b1, b2, b3 - regression co-efficients*

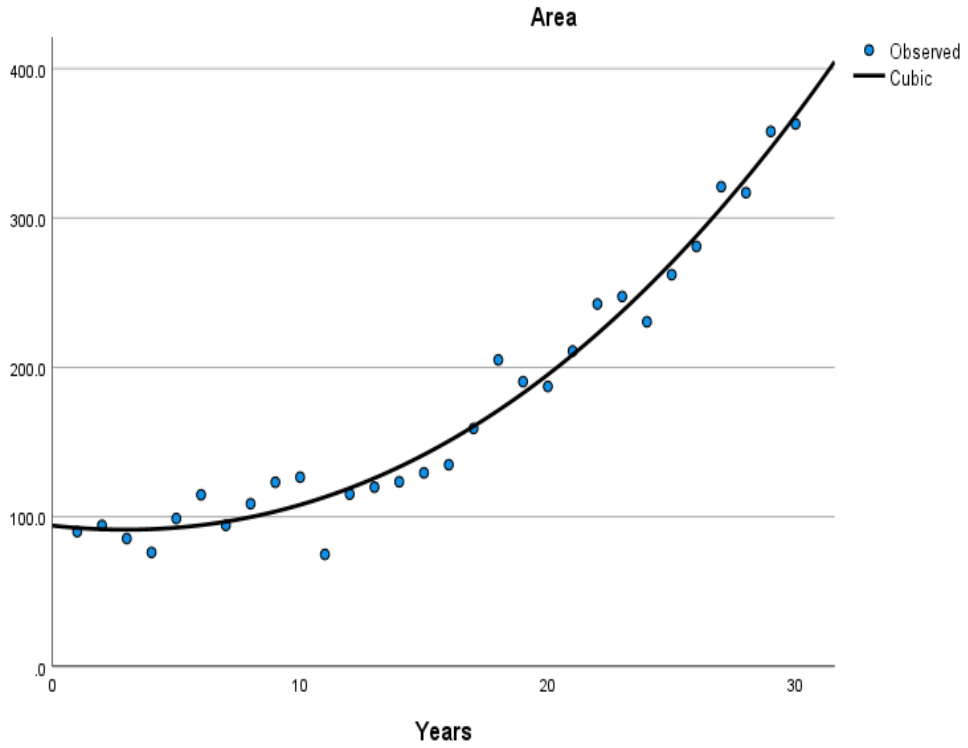

Fig. 1. Graphical presentation of cubic trend in area with years on X axis and variable area on Y axis

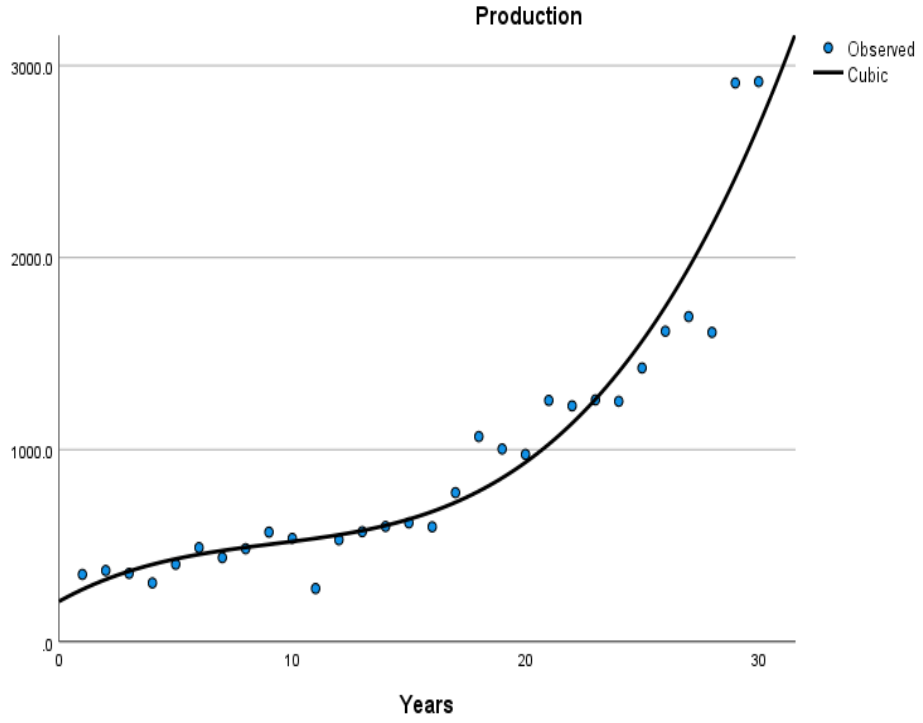

Fig. 2. Graphical presentation of cubic trend in production with years on X axis and variable production on Y axis

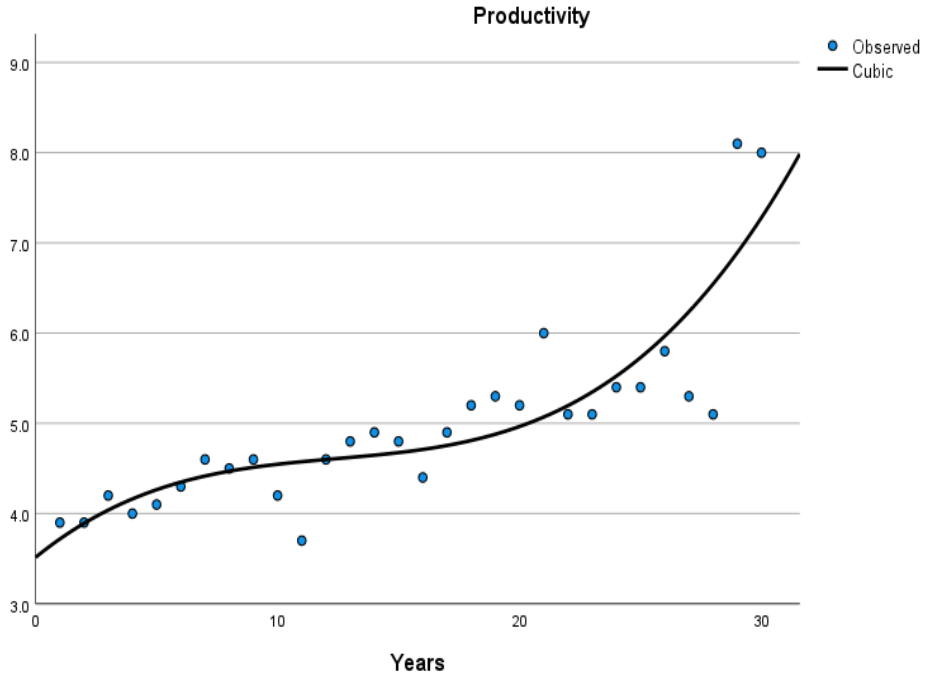

Fig. 3. Graphical presentation of cubic trend in productivity with years on X axis and variable productivity on Y axis

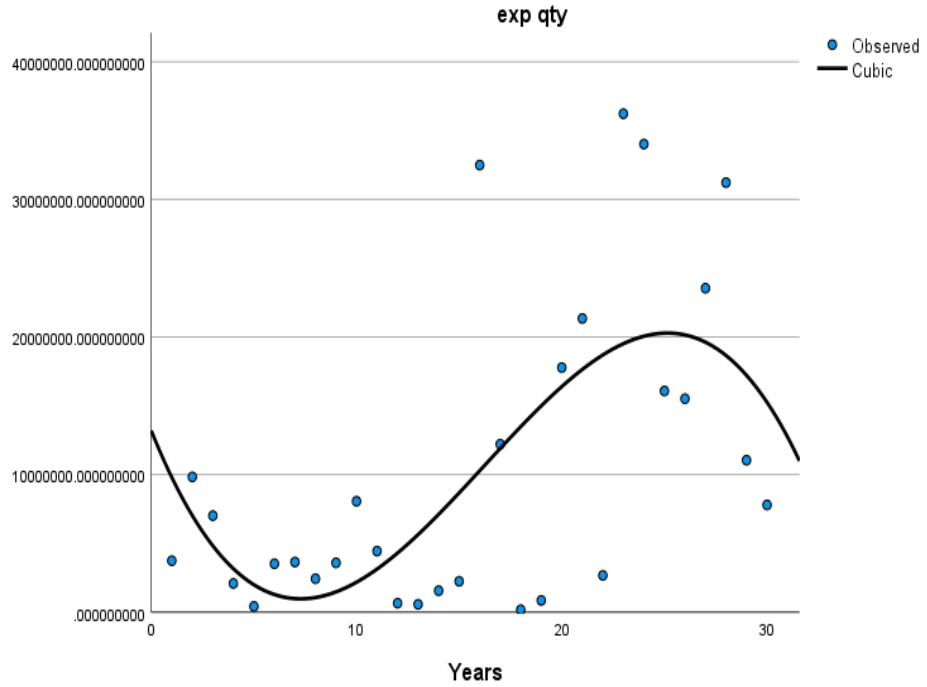

Fig. 4. Graphical presentation of cubic trend in export quantity with years on X axis and variable export quantity on Y axis

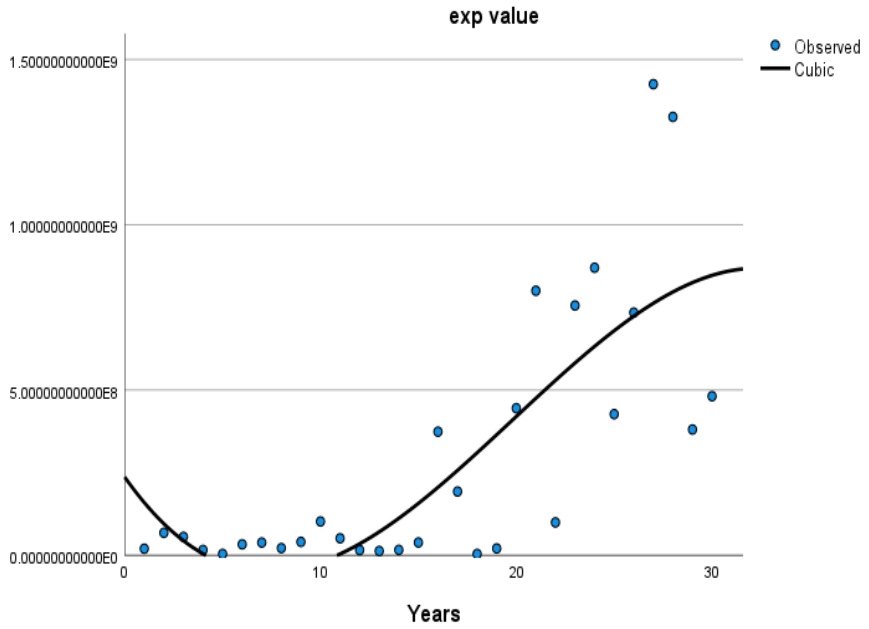

Fig. 5. Graphical presentation of cubic trend in export value with years on X axis and variable export value on Y axis

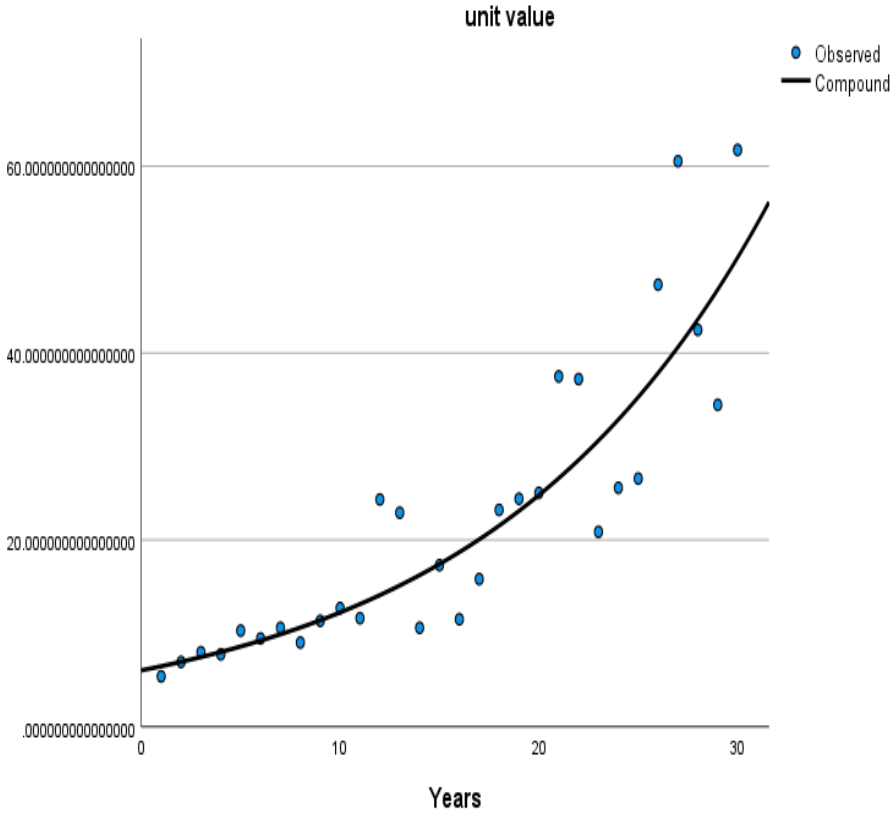

Fig. 6. Graphical representation of compound trend in unit value of export with years on X axis and unit export value on Y axis

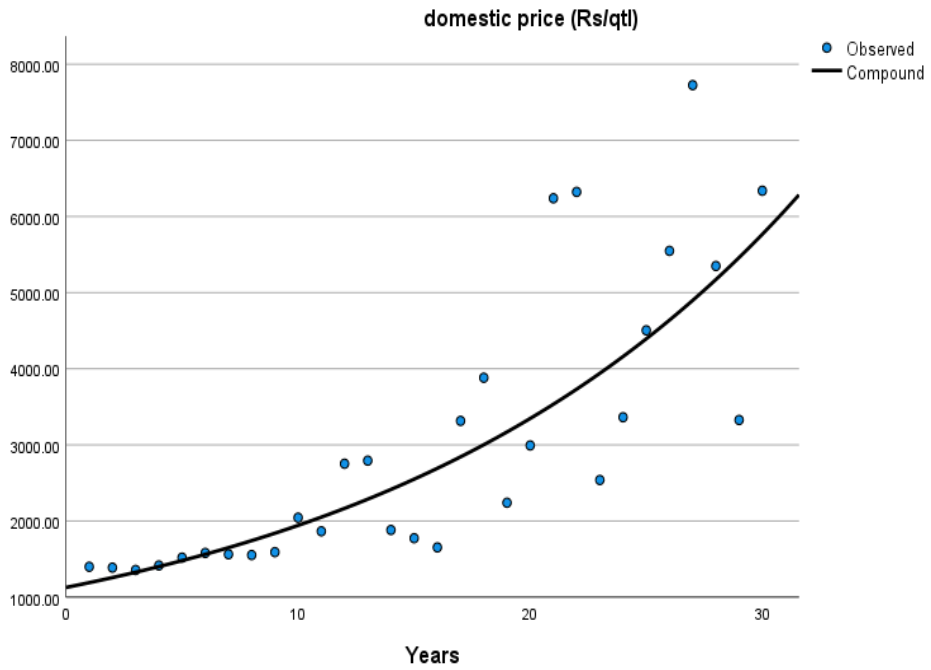

Fig. 7. Graphical representation of compound trend in domestic price of garlic

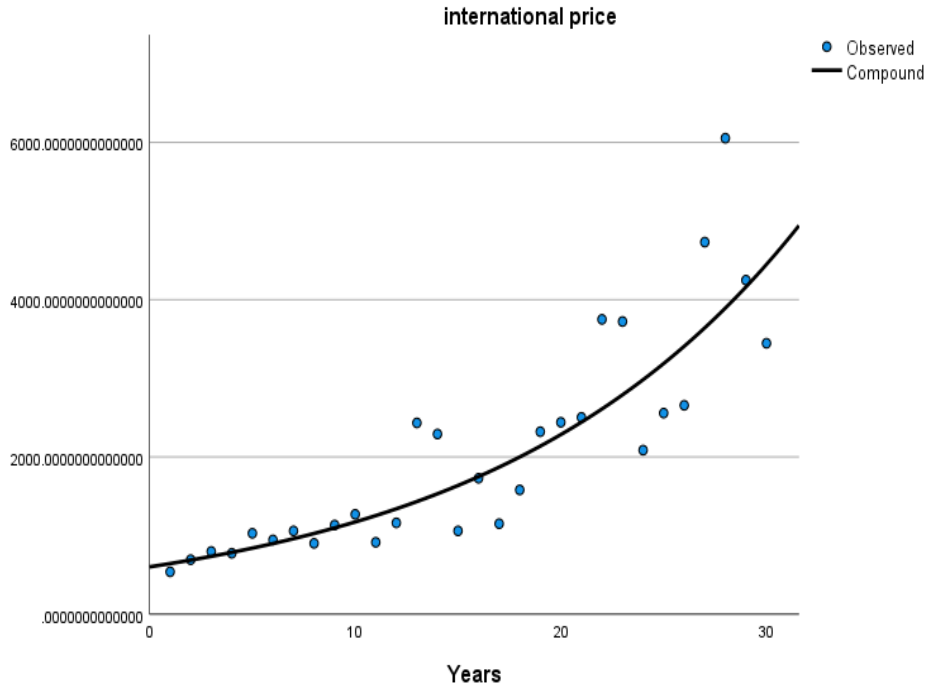

Fig. 8. Graphical representation of compound trend in international price

This may be due to changes in policy and their implications at different periods of time. Liberalization of trade policies impact the marketing structures and price received by farmers and other marketing middlemen. R^2 value of area, production, productivity, export value, unit value of export, domestic and international prices of garlic was significant at 1 per cent level except export quantity which was found to be significant at 5 per cent level.

Table 3. Export competitiveness of garlic

Year	Domestic price (Rs/Qtl)	International price (Rs/Qtl)	NPC
1990-1991	1399.67	539.68	2.59
1991-1992	1388.21	693.89	2.00
1992-1993	1357.53	798.19	1.70
1993-1994	1416.50	775.67	1.83
1994-1995	1519.91	1029.30	1.48
1995-1996	1581.04	945.25	1.67
1996-1997	1563.78	1059.90	1.48
1997-1998	1553.80	901.53	1.72
1998-1999	1591.69	1134.57	1.40
1999-2000	2044.68	1270.83	1.61
2000-2001	1865.69	914.88	2.04
2001-2002	2753.50	1162.30	2.37
2002-2003	2793.77	2433.45	1.15
2003-2004	1882.78	2292.05	0.82
2004-2005	1774.89	1060.01	1.67
Period I Average NPC (1990-91 to 2004-05)			1.70
2005-2006	1653.90	1729.92	0.96
2006-2007	3315.81	1151.43	2.88
2007-2008	3882.63	1581.06	2.46
2008-2009	2240.80	2321.66	0.97
2009-2010	2993.12	2441.07	1.23
2010-2011	6240.24	2503.77	2.49
2011-2012	6323.67	3750.29	1.69
2012-2013	2539.29	3722.42	0.68
2013-2014	3363.77	2086.65	1.61
2014-2015	4505.69	2557.86	1.76
2015-2016	5549.13	2657.19	2.09
2016-2017	7726.05	4732.45	1.63
2017-2018	5350.53	6054.29	0.88
2018-2019	3327.72	4248.84	0.78
2019-2020	6339.19	3446.08	1.84
Period II Average NPC (2005-06 to 2019-20)			1.60
Overall period Average NPC (1990-91 to 2019-20)			1.65

b) Export competitiveness of garlic

The export competitiveness of garlic was analysed using Nominal Protection Co-efficient. The competitiveness of market is based on NPC ratio. If NPC ratio is less than 0.5, the market is highly competitive. If NPC ratio varies between 0.5 to 1 then the market is moderately competitive and if the ratio is greater than one, then the market is non-competitive and it is presented in Table 3.

It was observed from the Table 3 that the NPC value of garlic in overall period was 1.65, indicating non-competitiveness of garlic in international markets. During period I and period II, average NPC values of garlic were 1.70 and 1.60 respectively indicating non-competitiveness of garlic for the period I and period II. Hence, the hypothesis i.e., Indian garlic has better competitiveness in international market is not accepted here. The results are similar to finding of [21] concluded that elasticity of export of Indian garlic is less than one indicating non-competitiveness of Indian garlic in international markets. Non-competitiveness of Indian garlic is due to high quality Chinese garlic contributing 90 per cent world garlic trade [23-27].

4. CONCLUSION

Trend analysis in area, production, productivity, export quantity, export value, unit value of export, domestic and international price of garlic was carried out by using wide range of parametric models. Among the competitive models, best model based on R^2 significance is fit to know the trend. It was observed that area, production, productivity, export quantity, export value of garlic

showed cubic trend indicating that the movement of all the series was uniform throughout India and for unit value of export, domestic and international prices of garlic, compound trend was observed to be best fit based on R^2 significance.

NPC values of garlic for period I was 1.70, for period II was 1.60 and for overall period was 1.65. NPC values indicate non-competitiveness of garlic in all the three periods.

It is important to increase export share of garlic by taking appropriate efforts. Market support by Government is necessary to support the farmers from considerable fluctuation in price and motivating them to produce a quality garlic.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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