

# **Growth and instability in production and export of selected spices of India**

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## **Abstract**

India is the largest producer and exporter of spices in the world and is rightly called the 'spice bowl of the world'. According to Bureau of Indian Standards (BIS), about 63 spices are being grown in our country. The estimated trade in spices from India for 2011-2012 was 5.75 lakh metric tonnes valued Rs. 9,783,42 crore (\$2037.76 million). Three spices, pepper, cumin and coriander, were selected for the study as they have the foremost position in the world spices trade in value terms. For this study statistical tools namely, compound growth rate analysis and coefficient of variation was employed. Our empirical results showed that area, production and productivity of pepper showed negative growth rate at national level. Pepper registered a positive but non-significant growth rate in terms of volume of export. At national level area under cumin showed only a meagre growth rate while production, productivity and export showed significant positive growth rate. Area, production and export of coriander showed significant and positive growth rate while productivity showed non-significant positive growth rate at national level. Area, production and productivity were found to be stable while export was found to be unstable in case of pepper. Similarly, at all India level, in case of cumin, area, production and productivity were found to be stable while export was found to be unstable. In case of coriander, area and productivity were found to be stable while production and export was found to be unstable.

**Key words** : Coriander, cumin, pepper, production and export, world spice trade

## **Introduction**

India is the largest producer and exporter of spices in the world and therefore known as the 'spice bowl of the world'. According to Bureau of Indian Standards (BIS), about 63 spices are being grown in our country. The estimated trade in spices from India for 2011-2012 was 5.75 lakh metric tonnes valued Rs. 9,783.42 crore (\$2037-76 million). India has a respectable position in the world spice trade with 48 per cent share in quantity and 44 per cent in value. Indian spice export for the year 2011-12 showed an increase of 9 per cent in volume and 43 per cent in rupee terms to the previous year. India produced 53.30 lakh tonnes of spices in 29.24 lakh hectares of land in the year 2010-11. The exports marked a rise of 36 per cent in dollar terms in the financial year 2011-12 as compared to 2010-11. The Indian spice industry realized its target for the year 2011-12 and the achievements were 115 percent in quantity, 151 per cent in rupee value and 141 per cent in dollar terms. The pepper, cumin and coriander were selected for the present study as they have the foremost position in the world spice trade in value terms. India stands first in the production of almost all the spices. Still

we are not able to exploit the full potential of these since these spices are often subjected to wide price fluctuation in the domestic as well as international markets. Looking to the importance of this, the present study was carried out to examine the growth in area, production, productivity and exports of pepper, cumin and coriander from India and to analyze the instability in exports of pepper, cumin and coriander from India.

## **Material and methods**

The growth and instability analysis was done at national level and at state level by selecting the foremost two states in case of production of pepper, cumin and coriander spices. The required data for the present study were collected for the period 2001-2010 from various official secondary sources.

### **Growth rate analysis**

In the present study, compound growth rates in area, production, productivity and export quantities of pepper, cumin and coriander in the country as a whole as well as two major growing states of these spices were estimated by using the exponential growth function of the form,

$$Y = ab^t U_t \quad (3.1)$$

Where,

Y = area, production, productivity and export quantities of pepper/cumin/ coriander in year 't'

a = intercept

b = regression coefficient

t = time variable and

$U_t$  = error term

The equation was estimated after transforming (3.1) as follow

$$\text{Log } y = \text{log } a + t \text{ log } b + \text{log } U_t \quad (3.2)$$

Then, the per cent compound growth rate (g) was calculated using the relationship

$$G = [(\text{antilog of } b) - 1] \times 100 \quad (3.3)$$

Significance of growth rate was judged by conducting student's t-test at 5 per cent and 1 per cent level of significance.

### ***Instability analysis***

In order to study the variability in the agricultural exports, coefficient of variation was used as a measure of instability

$$\text{C.V.} = \frac{\text{SD}}{\text{AM}} \times 100$$

Where,

C.V. = coefficient of variation, SD = standard deviation, AM = arithmetic mean

## **Results and discussion**

### ***Growth in area, production, productivity and exports of pepper, cumin and coriander***

The compound growth rates (used as growth rates hereafter) of area, production, productivity and exports of pepper, cumin and coriander for the period from 2001 to 2010 were computed. The crop wise results for the country as a whole as well as two important states growing these spices presented as follows :

#### ***Pepper***

The important states growing pepper are Karnataka and Kerala. It is evident from Table 1 that during the study period, the area under pepper in the country showed negative growth rate of (-) 2.73 per cent per annum. The area under pepper in the country showed increasing trend upto 2005 and thereafter it declined upto 2010. The maximum area under pepper was 260200 hectares in 2005 and it was minimum during 2008 (181299 ha). A positive and significant growth rate of area was observed in Karnataka (8.27%) as depicted in the table. In case of

Karnataka, the area under pepper decreased from 2001 to 2003 and then it increased upto 2005. In the year 2006, the area again marginally decreased and from 2006 onwards it increased upto 2010. The maximum area under pepper was 21061 hectares in 2010 and it was minimum during 2002 i.e. 10410 hectare. Mamatha (7) reported that this positive growth rate in case of Karnataka is not surprising since pepper is a commercial crop and flow of steady income to farmers has motivated them in expanding the area under the cultivation as pure crop as well as intercrop. Kerala showed a significant negative growth rate of (-) 3.32 per cent per annum during the study period.

The negative growth rate in case of Kerala may be due to the fact that farmers have started cultivating other high value commercial crops in place of pepper since they provide more returns. The area under pepper increased from the year 2001 to 2005, thereafter it declined upto 2008 and again it increased upto 2010 in Kerala. The maximum area under pepper was 237998 hectare in 2005 and it was minimum during 2008 (153711 ha).

At national level, the pepper production has shown a negative growth rate of (-) 5.00 per cent per annum as depicted in Table 1. The pepper production increased from the year 2001 to 2005 and thereafter it declined upto 2007. In the year 2007, 2008 and 2009 the production remained the same. The pepper production decreased in the year 2010. The pepper production was maximum in the year 2005 (92900 tonnes) and it was minimum during 2010 (48000 tonnes). The state wise analysis revealed that a remarkable significant growth in production was observed in Karnataka (23.68%). In case of Karnataka, the pepper production decreased from 2001 to 2002 and then it increased upto 2005. From 2005 to 2006, the pepper production was maximum in the year 2010 (18240 tonnes) and it was minimum during 2002 (2320 tonnes). Kerala showed a negative and significant growth rate of (-) 12.06 per cent per annum during the study period. Similar results were also observed by Jayasree et al (3). The pepper production increased from 2001 to 2005 and then it decreased upto 2010. The pepper production was maximum in the year 2005 (87605 tonnes) and it was minimum during 2010 (20640 tonnes). This was mainly due to decrease in area and productivity of pepper in Kerala state and due to incidence of phytophthora foot rot and pest attacks.

The productivity of pepper shown a negative growth rate of (-) 2.33 per cent per annum at national level. It was fluctuated year after year. The pepper productivity was maximum in the year 2005 (357 kg/ha) and it was minimum

Table 1: Area, Production and Productivity of Pepper (2001-2010)

Year	India			Karnataka			Kerala		
	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)
2001	218800	61600	282	12060	2950	245	203956	85240	286
2002	225500	72600	322	10410	2320	223	208607	67358	323
2003	234800	73400	313	10690	2360	221	216440	69015	319
2004	257700	79600	309	12340	2750	223	237669	74980	315
2005	260200	92900	357	14800	3240	219	237998	87605	368
2006	245970	69000	281	14000	3000	214	226100	64260	284
2007	198956	50000	251	16320	3624	222	175679	41952	239
2008	181299	50000	276	18847	6236	331	153711	33991	221
2009	198986	5000	251	19706	15000	761	171849	27500	160
2010	183780	48000	261	21061	18240	866	172182	20640	120
CGR (g)	-2.73	-5.00	-2.33	8.27*	23.68*	14.24**	-3.32**	-12.06*	-9.04*
t value	2.14	2.19	2.09	8.55	3.63	3.08	2.37	3.25	3.86

\*Significant at 1 per cent level of significance

\*\* Significant at 5 per cent level of significance

during 2007 and 2009 (251 kg/ha). The ups and downs in productivity of pepper was mainly due to favourable and unfavourable climatic conditions. A positive and significant growth rate in productivity was observed in Karnataka (14.24%). It decreased from 2001 to 2003 and then it increased from 2003 to 2004. From 2004 to 2006, the productivity of pepper again decreased and thereafter a remarkable increase was observed upto 2010. The pepper productivity was maximum in the year 2010 (866 kg/ha) and it was minimum during 2006 (214 kg/ha). Kerala showed a negative and significant growth rate of (-) 9.04 per cent per annum. The decline in productivity may be due to the poor management practices adopted by the farmers and heavy incidence of the dreadful disease, phytophthora foot rot (Jayesh, 4). A remarkable continuous decrease in productivity of pepper was observed from 2005 to 2010. The pepper productivity was maximum in the year 2005 (368 kg/ha) and it was minimum during 2010 (120 kg/ha). From Table 2, it is evident that pepper registered a positive but non-significant growth rate of 6.23 per cent per annum in terms of volume of export. The growth in quantity of pepper exported was mainly due to increased demand in the world market. The stringent quality measures implemented by the Spice Board, viz. Mandatory sampling and analysis in export consignment of pepper had made Indian pepper more acceptable in the international markets. The lower output by other major producers like Vietnam had also helped India to achieve performance. The pepper exports increased from the year 2001 to 2002 and thereafter it declined upto 2004. From 2004 to 2007, the pepper exports increased and thereafter it decreased upto 2010. The pepper export was maximum i.e. 36107 tonnes in the year 2007 and it was minimum during 2004 (9331 tonnes).

**Table 2.** Quantity Exported of Pepper from India (2001-2010)

Sl. No.	Year	Quantity Exported (tonnes)
1	2001	18,399
2	2002	18,577
3	2003	11,645
4	2004	9,331
5	2005	12,558
6	2006	22,128
7	2007	36,107
8	2008	28,197
9	2009	19,720
10	2010	19,464
	CGR (g)	6.23
	t value	1.38

### Cumin

The important two states growing cumin are Gujarat and Rajasthan. Table 3 elucidate that at national level area under cumin showed only a meagre growth rate of 0.87 per cent per annum. The area under cumin decreased from the year 2001 to 2004 and thereafter it increased upto 2008. From 2008 to 2010, the area under cumin again decreased. The maximum area under cumin was 572132 hectares in 2008 and it was minimum during 2005 (403030 ha). In Gujarat growth in area under cumin increased significantly at an annual rate of 8.95 per cent. The expansion in area in case of Gujarat is due to the remunerative income achieved by farmers then that with the cultivation of other crops. In case of Gujarat, the area under cumin increased from 2001 to 2003 and then it declined in the year 2004. From 2004 to 2008, the area under cumin again increased and thereafter it declined upto 2010. The maximum area under cumin was 359938 hectare in 2008 and it was only 145100 hectare during 2001. Rajasthan showed a negative growth rate of (-) 3.01 per cent per annum. The area under cumin decreased from the year 2001 to 2006, then it increased in the year 2007 and again it decreased in 2008. From year 2008 to 2010, the area under cumin in Rajasthan showed an increasing trend. The maximum area under cumin was 381534 hectare in 2001 and it was minimum (135110ha) during 2005.

It is also revealed from Table 3 that cumin production showed a significant positive growth rate of 7.70 per cent per annum at national level. The growth in production was mainly contributed by high productivity which was probably attributed to introduction of high yielding varieties coupled with Integrated Nutrient Management. Cumin production recorded inter-year fluctuations and there was no definite trend during the study period. The cumin production was maximum in the year 2010 (314220 tonnes) and it was minimum during 2004 (176070 tonnes). Gujarat showed higher significant growth of 18.95 per cent per annum in production. The cumin production increased from 2001 to 2003 and it decreased in the year 2004 probably due to unfavourable weather conditions. From 2004 to 2008, the cumin production increased and from 2008 onwards it decreased upto 2010. The cumin production was maximum in the year 2008 (242165 tonnes) and it was minimum during 2001 (61300 tonnes). Rajasthan showed a negative growth rate of (-) 4.55 per cent per annum. The negative growth rate in Rajasthan may be due to the incidence of cumin wilt, blight and powdery mildew which shows frequent appearance all through the major cultivating tracts in India as reported by Farooqi *et al.* (2). Cumin production

Table 3. Area, Production and Productivity of Cumin in India (2001-2010)

Year	India			Gujarat			Rajasthan		
	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)
2001	526630	206410	392	145,100	61,300	422	381,534	145,110	380
2002	521250	134750	259	200,050	64,280	321	321,200	70,480	219
2003	430840	202980	471	203,010	82,000	404	227,110	120,600	531
2004	367680	176070	479	154,000	79,500	516	159,540	69,090	433
2005	403030	199850	496	213,900	106,100	496	135,110	52,240	387
2006	409030	176510	432	259,217	152,845	590	149,816	23,666	158
2007	477936	264860	554	267,610	196,352	734	215,473	66,359	308
2008	527132	283000	537	359,938	242,165	673	165,703	39,362	238
2009	517133	303943	588	311,755	221,215	712	203,854	80,531	395
2010	507850	314220	619	292,847	219,215	749	330,634	114,925	348
CGR (g)	0.87	7.70*	6.77*	8.95*	18.95*	9.18*	-3.01	-4.55	-1.58
t value	0.54	4.41	4.49	4.91	8.37	7.46	0.89	0.92	0.54

\*Significant at 1 per cent level of significance

decreased in majority of years during the study period. The cumin production was maximum in the year 2001 (145110 tonnes) and it was minimum during 2006 (23666 tonnes).

At national level, cumin productivity has shown a significant growth rate of 6.77 per cent per annum. A mix trend was observed in cumin productivity during the study period. The cumin productivity was maximum in the year 2010 (619 kg/ha) and it was minimum during 2002 (259 kg/ha). Gujarat showed a positive and significant growth rate of 9.18 per cent per annum. The similar trend in productivity of cumin was observed in Gujarat as it was observed at national level. The cumin productivity ranged between 749 kg/ha in 2010 to 321 kg/ha in 2002. Rajasthan has shown a negative growth rate of (-) 1.58 per cent per annum. The cumin productivity was maximum in the year 2003 (531 kg/ha) and it was minimum during 2006 (158 kg/ha). Cumin production was more susceptible to weather fluctuations observed in Rajasthan.

Table 4 reveals that the quantity of cumin exported from India showed a very high positive and significant growth rate of 23.28 per cent per annum. The export has increased significantly due to large demand from abroad and due to competitive prices. The cumin export decreased and increased as per the overseas demand and total production. Maximum quantity of cumin exported was 75,041 tonnes during 2008 and it was minimum i.e. 6878 tonnes in 2003.

**Coriander**

Two important states growing coriander are Rajasthan and Madhya Pradesh. From Table 5 it is apparent that at national

**Table 4.** Quantity Exported of Cumin from India (2001-2010)

Sl. No.	Year	Quantity Exported (tonnes)
1	2001	15,818
2	2002	11,256
3	2003	6,878
4	2004	11,229
5	2005	10,660
6	2006	31,214
7	2007	32,805
8	2008	75,041
9	2009	43,762
10	2010	42,005
	CGR (g)	23.28*
	t value	3.31

\*Significant at 1 per cent level of significance

level coriander has shown a significant annual compound growth in area of 12.10 percent per annum. The area under coriander mostly decreased during the study period except from 2004 to 2008 and 2010 when the area under coriander increased. The maximum area under coriander was 537327 hectares in 2008 and it was minimum during 2002 (243300 ha). The increase and decrease in area under coriander was probably due to high price volatility. Among the states cultivating coriander, Madhya Pradesh showed the highest significant compound growth rate of 6.66 per cent per annum in area. The area under coriander also fluctuated over the years but increase in area was more pronounced than decrease in area. The maximum area under coriander was 150464 hectares in 2009 and 2010 and it was minimum during 2002 (62100 ha). Rajasthan also showed a positive growth rate of 3.64 per cent per annum. The maximum area under coriander was 245100 hectares in 2008 and it was minimum during 2002 i.e. 112300 hectare. The fluctuation in area over the years was also observed.

Table 5 reveals that coriander production has shown a positive and significant annual growth of 8.19 per cent at national level. The fluctuation in coriander production was more pronounced over the years because of fluctuation in weather conditions (Ajjan *et al* ,1). The coriander production was maximum i.e. 501485 tonnes in the year 2009 and it was minimum during 2002 (164900 tonnes). Madhya Pradesh showed highest significant growth rate of 12.07 per cent per annum towards coriander production. In case of Madhya Pradesh, the coriander production decreased from 2001 to 2002 and it increased in the year 2003. From 2003 to 2005, the coriander production decreased and thereafter it increased upto 2009. The production remained the same in 2009 and 2010. The coriander production was maximum in the year 2010 (70872 tonnes) and it was minimum during 2002 (12700 tonnes). Rajasthan showed a positive but non-significant growth rate of 3.66 per cent per annum in coriander production. The increase in production can be attributed to higher productivity (Kumawat and Meena,6). The coriander production fluctuated during the study period. The coriander production was maximum in the year 2003 (300100 tonnes) and it was minimum during 2002 (122700 tonnes). The trend in production was in line with the trend in area under coriander in Rajasthan during 2001 to 2010 showing the more area effect rather than productivity effect on production.

The productivity of coriander has shown a positive growth rate of 2.22 per cent per annum at national level. The fluctuation in productivity at national level is less compared to the state level. The coriander productivity was maximum

Table 5. Area, Production and Productivity of Coriander in India (2001-2010)

Year	India			Madhya Pradesh			Rajasthan		
	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)
2001	429200	319400	744	103,800	38,000	366	204700	234000	1143
2002	243300	164900	678	62,100	12,700	205	12300	122700	1093
2003	483500	389800	806	125,100	47,000	376	241400	300100	1243
2004	282500	248000	878	115,900	45,000	388	148400	169800	1144
2005	357040	257070	720	112,800	42,000	372	136700	142400	1042
2006	361770	287650	795	108,400	43,600	402	131100	155100	1183
2007	457605	286414	626	138,122	44,667	323	212800	245400	1153
2008	537327	471515	878	141,393	59,075	418	245100	273500	1116
2009	530789	501485	945	150,464	70,872	471	232100	281100	1212
2010	530860	482230	908	150,464	70,872	471	197891	218899	1106
CGR (g)	5.84**	8.19**	2.22	6.66*	12.07*	5.07**	3.64	3.66	0.02
t value	2.38	2.78	1.76	3.89	4.16	2.65	1.1	0.94	0.03

\*Significant at 1 per cent level of significance

\*\*Significant at 1 per cent level of significance

in the year 2009 (945 kg/ha) and it was minimum during 2007 (626 kg/ha). Madhya Pradesh recorded a positive and significant growth rate of 5.07 per cent per annum as depicted in Table 5, but the productivity was very low as compared to national average. The coriander productivity was maximum in the year 2010 (471 kg/ha) and it was minimum during 2002 (205 kg/ha). A meagre growth in productivity was observed in case of Rajasthan (0.02%). The coriander productivity was maximum in the year 2003 (1243 kg/ha) and it was minimum during 2005 (1093 kg/ha), but the highest in the country because of technological support and suitable cultivation condition. The fluctuation in coriander productivity was mainly due to incidence of pests and weather conditions.

It is evident from the Table 6 that coriander export has showed significant growth rate of 12.10 per cent per annum in terms of quantity. The consumption of more spicy foods in developed countries and the large Indian population in these countries has resulted in increase in the demand of coriander overseas. Similar observations were recorded by Krishnadas (5). The coriander exports increased from the year 2001 to 2004 and thereafter it decreased upto 2006. From 2006 to 2009, the coriander export increased and then it decreased in the year 2010. The coriander export was 38382 tonnes (maximum) in the year 2009 and it was minimum (11910 tonnes) in 2001.

***Instability in export of pepper, cumin and coriander from India***

The instability in export of major spices i.e. pepper, cumin and coriander from India during the period 2001-2010 was computed and presented as follows:

**Table 6.** Quantity Exported of Coriander from India (2001-2010)

Sl. No.	Year	Quantity Exported (tonnes)
1	2001	11,910
2	2002	14,585
3	2003	14,813
4	2004	31,935
5	2005	27,984
6	2006	24,890
7	2007	29,953
8	2008	35,872
9	2009	38,382
10	2010	28,862
	CGR (g)	12.10*
	t value	4.12

\*Significant at 1 per cent level of significance

***Pepper***

The quantity of pepper exported had shown instability of 40.71 per cent as depicted in Table 7. The increased demand in the world market and the lower output by other major producers like Vietnam had led to instability in export. At all India level, area under pepper cultivation showed instability of 13.22 per cent. Pepper production and productivity had showed instability of 25.65 and 11.81 per cent respectively. The area, production and productivity were found to be stable indicated by low coefficient of variation. Instability of 25.48, 96.64 and 70 per cent in area, production and productivity of pepper was noticed in case of Karnataka. Area was found to be stable indicated by low coefficient of variation while production and productivity were found to be unstable indicated by high coefficient of variation. In case of Kerala, area, production and productivity had showed instability of 15.08, 40.78 and 29.62 per cent respectively. Area and productivity were found to be stable indicated by low coefficient of variation whereas production was found to be unstable indicated by high coefficient of variation probably due to productivity instability.

***Cumin***

Cumin export indicated high instability of 76.49 per cent as shown in Table 8. The instability was the upshot of tremendous growth in quantity of cumin exported due to increased demand in the world market particularly after 2006. During the study period from 2001-2010, area under cumin cultivation showed an instability of 12.92 per cent. At all India level, cumin production and productivity had showed instability of 26.96 and 21.74 per cent, respectively. The area, production and productivity were found to be stable indicated by low coefficient of variation. Instability of 28.88, 50.58 and 27.12 per cent in area, production and productivity of cumin were noticed in case of Gujarat. Area and productivity were found to be stable indicated by low coefficient of variation while production was found to be unstable indicated by high coefficient of variation. In case of Rajasthan, area, production and productivity had showed instability of 37.63, 48.71 and 32.73 per cent respectively. Area production and productivity were found to be unstable indicated by high coefficient of variation for the state.

***Coriander***

It is understandable from Table 9 that the export of coriander has shown instability of 35.66 per cent whereas area under coriander cultivation had shown instability of 25.18 per cent. The coriander production and productivity showed instability of 33.61 and 13.18 per cent, respectively at national level. The area, production and productivity were found to be stable indicated by low

Table 7. Instability Analysis of Area, Production, Productivity and Quantity Exported of Pepper (2001-2010)

Particulars	India			Karnataka			Kerala			
	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Quantity Exported (tonnes)	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)
SD (σ)	29160.49	15313.79	34.27	7983.49	3827.12	5771.44	246.71	30227.74	22246.53	78.05
AM (γ)	220599.10	59710.00	290.21	19612.60	15023	5972.00	352.45	200383.10	54554.10	263.53
C.V. (%)	13.22	25.65	11.81	40.71	25.48	96.64	70.00	15.08	40.78	29.62

Table 8. Instability Analysis of Area, Production, Productivity and Quantity Exported of Cumin (2001-2010)

Particulars	India			Gujarat			Rajasthan			
	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Quantity Exported (tonnes)	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)
SD (σ)	60559.17	60994.21	104.89	21467.43	69522.40	72108.44	152.24	86173.24	38105.01	111.17
AM (γ)	468851.10	226259.30	482.54	28066.80	240743	142566.30	561.65	228997	78236.30	339.66
C.V. (%)	12.92	26.96	21.74	76.49	28.38	50.58	27.12	37.63	48.71	32.73

Table 9. Instability Analysis of Area, Production, Productivity and Quantity Exported of Coriander (2001-2010)

Particulars	India			Madhya Pradesh			Rajasthan			
	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Quantity Exported (tonnes)	Area (ha)	Production (tonnes)	Productivity (kg/ha)	Area (ha)	Production (tonnes)	Productivity (kg/ha)
SD (σ)	106105.50	114558.85	105.18	9242.97	26830.64	16956.19	76.61	49649.70	63025.60	58.95
AM (γ)	421389.10	340846.40	797.77	25918.60	120854	47378.60	379.24	186249.10	214299.90	1143.42
C.V. (%)	25.18	33.61	13.18	35.66	22.20	35.79	20.20	26.66	29.41	5.16

coefficient of variation. During the same time the production was found to be unstable indicated by coefficient of variation. Instability of 22.20, 35.798 and 20.20 per cent in area, production and productivity of coriander were noticed in case of Madhya Pradesh. Area and productivity were found to be stable indicated by low coefficient of variation while production was found to be unstable indicated by high coefficient of variation. In case of Rajasthan, area, production and productivity had showed instability of 26.66, 29.41 and 5.16 per cent respectively. Area, production and productivity were found to be stable indicated by low coefficient of variation during the study period specially the productivity of coriander in Rajasthan.

## **Conclusion**

### **Pepper**

The growth in area, production and productivity under pepper were found to be negative at the national level, while exports registered a positive but non-significant growth rate. The instability in export was high whereas instability in area, production and productivity was low.

### **Cumin**

The area under cumin showed only a meagre growth rate. Growth in production, productivity and export of cumin were found to be positive and significant at the national level. The instability in export was high whereas instability in area, production and productivity was low.

### **Coriander**

The growth in area, production and productivity of coriander were found to be positive and significant at the national level, while productivity registered a non-significant and positive growth rate. The instability in export was high whereas instability in area, production and productivity was low.

### **Policy Implications**

Since the area, production and productivity of pepper is showing a decreasing trend over the years, emphasis

should be given for promotional programmes to increase the area, production and productivity of pepper. The instability of export of these spices is mainly due to increased value of Indian spices in the world markets. Appropriate measures should be taken to stabilize the prices. The production of cumin and coriander fluctuate widely and the prices are very much volatile. Therefore, to protect the interest of farmers minimum support prices may be announced.

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