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## A study on growth, instability and direction of chilli trade in India

N Ashoka, C Kuldeep<sup>1</sup>, V A Ramachandra<sup>2</sup> & R A Yeledhalli

*Department of Agribusiness Management,  
University of Agricultural Science, Dharwad-580 005, Karnataka, India.  
E-mail: [narayana.ashoka@gmail.com](mailto:narayana.ashoka@gmail.com)*

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### Abstract

This study was aimed at studying growth, instability in area, production and productivity and direction of trade of chilli from India. Compound growth rate analysis, Instability analysis and Markov chain analytical tools were used for the study. The results indicated that the growth in area under chilli was negative, while production showed increasing growth due to increased productivity. The sources of instability in chilli production were found to be change in area variance and change in yield variance. Malaysia, Sri Lanka, United Arab Emirates and Indonesia were found to be the loyal markets for Indian chillies. The influence of export price and production on the changes in export of chilli was positive, but the influence of domestic price was negative.

**Keywords:** area, chilli, export, instability, production, productivity

India is the largest producer and exporter of spices in the world. According to Bureau of Indian Standards (BIS), about 63 spices are being grown in our country. During the year 2009–10, India achieved spice exports of 5.02 lakh metric tonnes valued at Rs. 5,560 crores in which export of chilli accounted for 40.58% in quantity (2.04 lakh MT) and 23% in value (1,291 crores).

Chilli also called red pepper or capsicum is an important well known commercial crop used as a condiment, culinary supplement or as a vegetable. Among the spices consumed per head in India, dry chilli has a major share. In India, chillies are grown in almost all states. Chilli occupies 7.67 lakh hectare area with production

of 15.86 lakh tonnes in the country. The important states growing chilli in terms of production are Andhra Pradesh (49%), Karnataka (15%), Orissa (8%), Maharashtra (6%), West Bengal (5%), Rajasthan (4%) and Tamil Nadu (3%). Even though India occupies a dominant position in production of chilli, we are still not able to exploit the full potential of this crop because the low chilli prices are often subjected to wide price fluctuations in the domestic as well as international markets. The current study on growth rates and instability in terms of area, production, yield and exports will help the scientists, producers and policy makers to devise appropriate policies to enhance spice production and export to meet

<sup>1</sup>Agriculture Cooperation, Banking and Marketing Polytechnic, Krishi Vignana Kendra, Waghai, Gujarat-394 730, India.

<sup>2</sup>Department of Agricultural Economics, University of Agricultural Sciences, Dharwad-580 005, Karnataka, India.

requirements of both domestic and international markets. In this regard, the present study was undertaken with the objectives: (1) To analyze the growth in area, production, productivity and export of chilli in India, (2) To analyze the instability in area, production, productivity and export of chilli in India and (3) To study the direction of trade of export chilli from India.

The data on area, production and productivity of chilli in India, national level and state wise for Andhra Pradesh, Karnataka, Orissa, Maharashtra and West Bengal, were collected for the period 1995–96 to 2009–10. The data pertaining to export was collected for the period 2001–02 to 2008–09 from the official websites of Spices Board, Kochi (India), Indian Institute of Spice Research, Kozhikode (India) and Directorate of Economics and Statistics, New Delhi. Analytical tools such as Compound growth rate, Instability analysis and Markov chain were used in the study.

Compound growth rate analysis done using following formula

$$Y_t = a b^t U_t$$

Where,  $Y_t$ =Dependent variable for which growth rate was estimated (area, production, yield, quantity, value and unit value of exported in year 't');  $a$ =Intercept;  $b$ =Regression coefficient;  $t$ =Year which takes values 1, 2, ...  $n$ ;  $U_t$ =Disturbance term in year 't'.

The equation was transformed into log-linear and written as

$$\log Y_t = \log a + t \log b + \log U_t$$

Equation was estimated by using Ordinary Least Square (OLS) technique.

The compound growth rate ( $g$ ) was then estimated by the identity given in equation

$$g = (b-1) \times 100$$

Where,  $g$ =Estimated compound growth rate per annum in %;  $b$ =Antilog of  $\log b$

The extent of variability in area, production, productivity and export of chilli were analyzed through coefficient of variation.

Before using the data for instability analysis, the time series data on area and productivity were first detrended to remove the trend component using linear trend equation of the form

$$Y_t = a + b_t + U_t$$

Where,  $Y_t$ =dependent variable (area in hectare and yield in  $\text{kg ha}^{-1}$ );  $t$ =time period in years;  $a$ =intercept;  $b$ =regression coefficient;  $U_t$ =residual term

The trade directions of chilli exports were analyzed using the first order Markov chain approach. Central to Markov chain analysis is the estimation of the transitional probability matrix  $P$ . The elements  $P_{ij}$  of the matrix  $P$  indicates the probability that export will switch from country  $i$  to country  $j$  with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports.

From 2001–02 to 2008–09, six major importing countries were considered. The average exports to a particular country was considered to be a random variable which depends only on the past exports to that country, which can be denoted algebraically as

$$E_{jt} = \sum_{i=1}^r E_{it-1} P_{ij} + e_{jt}$$

Where,  $E_{jt}$ =Exports from India to  $j^{\text{th}}$  country during the year  $t$ ;  $E_{it-1}$ =Exports to  $i^{\text{th}}$  country during the period  $t-1$ ;  $P_{ij}$ =Probability that the exports will shift from  $i^{\text{th}}$  country to  $j^{\text{th}}$  country;  $e_{jt}$ =The error term which is statistically independent to  $E_{it-1}$ ;  $t$ =Number of years considered for the analysis;  $r$ =Number of importing countries

The transitional probabilities  $P_{ij}$  which can be arranged in a  $(c * r)$  matrix, have the following properties.

$$0 \leq P_{ij} \leq 1$$

$$\sum P_{ij} = 1^r, \text{ for all } i$$

Thus, the expected export shares of each country during period 't' were obtained by multiplying the export to these countries in the previous period (t-1) with the transitional probability matrix.

The states like Andhra Pradesh, Karnataka, Maharashtra and West Bengal are the leading producer of chilli in India. Hence, the study focused on growth and instability in area, production and productivity among these states. At National level, chilli showed growth rates in area, production and productivity to the tune of -0.14%, 3.58% and 3.96% respectively (Table 1). In the state wise area growth rates, the highest growth rate per annum was found in West Bengal (2.98%) followed by Andhra Pradesh (1.43%) per annum. Karnataka state recorded the highest growth rate with respect to production of chilli to the tune of 6.68% followed by West Bengal to the tune of 4.99% per annum. Karnataka state also stands first with respect to the productivity accounting for 6.32% growth rate annually followed by Andhra Pradesh (4.60%) per annum. The lowest growth rate in productivity was recorded in Maharashtra (0.29%) per annum.

The decrease in the growth rate of chilli was associated with increase in pest & disease occurrence and occurrence of drought in the state. The findings of the study supported the results obtained by Rajur *et al.* (2008).

The instability at the national level showed was 8.49% in area, 29.01% in production and 28.31% in case of productivity (Table 2). West Bengal state showed highest instability area (26.48%) and least was recorded in the state of Orissa (13.63%). As chilli is confined to agro-climatic zones, the scope of variability in area is low. The highest instability was recorded in the state of Karnataka in production to the tune of 56.44% followed by Andhra Pradesh (44.82%). The instability was mainly contributed by high productivity of high yielding varieties used by the farmer. The findings of the study are on par with the results obtained by Veeranna *et al.* (2011). Karnataka and Andhra Pradesh stood first and second with respect to instability in case of productivity to the tune of 52.03% and 32.12% respectively. The instability in productivity was mainly due to climatic conditions, pest & disease attack, etc. Highest growth in production was observed in

**Table 1.** Percentage of annual growth in area, production and productivity of chilli in India

Sl. No.		Area	Production	Productivity
1.	Andhra Pradesh	1.43*	4.95*	4.60*
2.	Karnataka	0.13	6.68*	6.32*
3.	Orissa	0.31	0.79	0.52
4.	Maharashtra	-1.93*	-1.58*	0.29
5.	West Bengal	2.98*	4.99*	2.12*
	India	-0.14	3.58*	3.96*

\*indicates significance at 1% level

**Table 2.** Percentage of instability in area, production and productivity of chilli in India

Sl. No.		Area	Production	Productivity
1.	Andhra Pradesh	15.31	44.82	32.12
2.	Karnataka	14.27	56.44	52.03
3.	Orissa	13.63	17.12	7.94
4.	Maharashtra	17.02	13.46	6.01
5.	West Bengal	26.48	38.34	16.92
	India	8.49	29.01	28.31

Karnataka state due to usage of high yielding varieties and adoption of improved package of practices. Similar results were found by Patel (1986) in tobacco.

The growth rate & instability of chilli export from India is shown in Table 3. The growth rate in export of chilli from India (in terms of quantity of export) recorded 16.98% per annum whereas there was a tremendous growth in export value to tune of 24.59% per annum and annual growth in export price was 8.70%. The instability in export in terms of export quantity, exports value and export price was calculated to be 93.65%, 52.34% and 121.01% respectively. The reason for instability can be attributed to the cultivation of high yielding varieties across the country which has greater demand in international markets.

**Table 3.** Percentage of instability and export growth performance of chilli from India

Parameters	Export quantity	Export value	Export price
Export growth (per annum)	16.98*	24.59*	8.70*
Instability	93.65	52.34	121.01

\*indicates significance at 1% level

Transitional probability matrix of chilli exports is given in Table 4. Malaysia was found to be the most stable importer of Indian chillies as it retained its original share of around 87.88% which was the highest among the importing countries. It lost its minor share of 12.12% to United Arab Emirates and Indonesia. Malaysia was the largest buyer of Indian chillies followed by other traditional buyers like Bangladesh, Sri

Lanka, United States of America, United Arab Emirates and Indonesia.

Sri Lanka was also found to be stable with 27.56% of retention of its shares while losing a major share of 72.44% to United States of America, Malaysia, United Arab Emirates, Indonesia and other countries. United Arab Emirates was also found to be stable with 30.13% of retention of its shares while losing a major share of 69.87% to Bangladesh, Malaysia and other countries.

Other countries were also found to be stable with 55.31% of retention of their shares while losing a share of 44.69% to United States of America. The stringent quality measures implemented by the Spices Board, *viz.*, mandatory sampling and analysis for the presence of aflatoxins and adulterants in export consignment has made Indian chilli more acceptable in the international markets. The lower output by other major producers like China and Pakistan has also helped India to achieve record performance.

From the study it could be concluded that the compound annual growth rate of chilli area was negative due to competing crops like soybean whereas compound annual growth rate of area was 3.58% per annum as farmers used high yielding varieties and adopted improved cultivation practices. West Bengal state showed highest instability in area. The highest instability was recorded in the state of Karnataka in production. The instability was mainly contributed by high productivity of high yielding varieties. Malaysia was found to be the most stable importer of Indian chillies as

**Table 4.** Transitional probability matrix of chilli exports 2001–02 to 2008–09

Country	Malaysia	Bangladesh	Sri Lanka	U.S.A	U.A.E.	Indonesia	others
Malaysia	0.8788	0.0000	0.0000	0.0000	0.0385	0.0827	0.0000
Bangladesh	0.3417	0.0000	0.1830	0.0000	0.0000	0.0000	0.4753
Sri Lanka	0.0127	0.0000	0.2756	0.4390	0.0404	0.0576	0.1747
U.S.A	0.0000	0.3925	0.5553	0.0000	0.0462	0.0000	0.0060
U.A.E.	0.1374	0.2063	0.0000	0.0000	0.3013	0.0000	0.3550
Indonesia	0.0000	0.8502	0.0000	0.0000	0.0000	0.1498	0.0000
Others	0.0000	0.0000	0.0000	0.4469	0.0000	0.0000	0.5531

it retained its original share of around 87.88% which was the highest among the importing countries.

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