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The names and affiliations of all authors are provided below, following the references.

Instability analysis of green chilli exports from India

Zimare MD¹, JS Kumbhar², TB Deokate³, YC Sale⁴, AA Bhagat⁵, PV Munde⁶, AK Shinde⁷

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ABSTRACT

The present study examine export quantity, value and unit export price data from DGCIS and APEDA to investigate the volatility of India's green chili exports from 2005–06 to 2024-25. Export performance growth and fluctuations throughout various time periods and key destination countries were evaluated using the coefficient of variation (CV) and CDVI. While the corresponding CDVI values were 27.86, 18.80 and 16.95 per cent, respectively, for the entire period, the CV was 53.47 per cent for export quantity, 79.43 per cent for export value and 48.04 per cent for export price, suggesting positive growth with significant variation. The findings indicate that India's green chili exports have expanded over time, but they continue to experience significant fluctuations across markets and export components, Emphasizing the importance of market diversification, better export planning and measures. Country-wise results showed marked differences in export stability, with Bangladesh exhibiting the highest volatility in export quantity and value and Kuwait exhibiting the highest variability in export value and price.

Keywords: Instability, Export, Green Chilli, India

Introduction

Green chili (*Capsicum annum* L.), a member of the Solanaceae family, is a significant vegetable and spice crop grown in India for both local and export purposes. Its distinct pungency, flavor and nutritional value, particularly its vitamin and mineral content, make it an essential component of Indian cuisine and the food business. India is one of the world's biggest chili producers, with a well-established export market that includes the United Arab Emirates, Bangladesh and the Gulf countries. Districts like Aurangabad and Nandurbar in Maharashtra are key production and marketing centers, with the G4 type gaining popularity in export markets because to its appealing colour, elongated shape, firmness and comparatively long shelf life. However, perishability, quality standards, pesticide residue limits, grading, packaging, cold-chain facilities, transportation and phytosanitary requirements all have an impact on fresh green chili exports. Efficient post-harvest handling and export procedures are thus critical to maintaining product quality and minimizing losses. Given the increasing demand for Indian green chili in international markets, understanding its production, marketing and export systems is critical for improving export efficiency, strengthening the value chain and increasing the returns of growers and other stakeholders.

Materials and methods

The study was mainly based on secondary data. The time series data was collected for 20 years from the year 2005-06 to 2024-25. The secondary data pertaining to quantity and value and price of green chilli exported by India to major importing destinations was collected from the Directorate of General Commercial Intelligence and Statistics (DGCIS), Government of India and National Agricultural Processed Food Product Export Development Authority (APEDA).

Coefficient of Variation (CV %)

To investigate the variability of time series data, the coefficient of variation (CV) is employed as an indicator of instability. Where the series' trend coefficients are significant, the variation around the trend rather than the variation around the mean (CV) is employed to measure the instability as an indicator of instability.

$$CV (\%) = (S.D./Mean) \times 100$$

where,
 CV = Coefficient of Variation
 SD = Standard Deviation

Corresponding Author: Zimare MD

M. Sc. Scholars, Division of
 Agricultural Economics,
 Govt. College of
 Agriculture, Pune,
 Mahatma Phule Krishi
 Vidyapeeth, Rahuri,
 Maharashtra, India

$$\text{Mean} = \sum X_i / N$$

X_i = Country wise exported quantity or value of Green Chilli from India

N = Number of years

a. Cuddy Della and *Vella* Instability Index.

$$\text{CDVI} = \text{CV} \times \sqrt{(1 - R^2)}$$

R^2 = Coefficient of determination from time trend regression adjusted by the of degrees of freedom

Classification criteria of instability

- Low Instability: CDVI < 15 per cent
- Medium Instability: 15 per cent- 30 per cent
- High Instability: CDVI > 30 per cent

The coefficient of variation was employed to quantify instability, however time series data frequently include a trend component. To address this trend component and provide meaningful measurement of instability, CV is changed as recommended by Cuddy and Della and referred to as the Cuddy and Della instability index. It attempts to de-trend CV by using coefficient of determination (R^2).

where,

CV = Coefficient of variation in per cent (%)

Result and discussion

Export performance of green chilli export from India

Table 1 displays the variability in green chili exports from India across the study period (2005-06 to 2024-25), as measured by the coefficient of variation (CV) and CDVI. Export value had the highest CV (79.43%), followed by export quantity (53.47%) and export price (16.95%), showing that export value fluctuated more than quantity and price. The CDVI was highest for export quantity (27.86%), followed by export value (18.80%) and export price (16.95%). The CDVI readings for all variables are positive, indicating an overall increase in India's green chili exports.

Table 1. Export Trends of Green Chilli from India

Sr. No	Year	Quantity (MT)	Value (₹ Lakhs)	Price (₹/ kg)
1	2005-2006	8764.72	1482.57	16.92
2	2006-2007	18,187.83	2,216.38	12.19
3	2007-2008	26,894.86	4,372.14	16.26
4	2008-2009	30,198.13	4,832.05	16.00
5	2009-2010	30,654.67	6,287.07	20.51
6	2010-2011	28,441.66	6,122.29	21.53
7	2011-2012	46,702.98	9,824.21	21.04
8	2012-2013	35,991.98	9,154.15	25.43
9	2013-2014	46,540.18	14,086.95	30.27
10	2014-2015	32,138.20	13,613.60	42.36
11	2015-2016	43,946.59	18,647.46	42.43
12	2016-2017	45,008.30	21,707.69	48.23
13	2017-2018	44,903.27	22,074.05	49.16
14	2018-2019	39,735.17	21,311.18	53.63
15	2019-2020	44,415.74	25,976.32	58.48
16	2020-2021	92,282.77	39,364.79	42.66
17	2021-2022	52,370.24	31,046.91	59.28
18	2022-2023	51,132.00	37,076.27	72.51
19	2023-2024	79,852.38	45,925.59	57.51
20	2024-2025	110,907.82	55,466.86	50.01
	CV (%)	53.47	79.43	48.04
	CDVI (%)	27.86	18.80	16.95

(Source: DGCIS, APEDA)

Instability in green chilli export from India

Table 2 depicts the fluctuation and growth in green chili exports from India during Periods I, II and the entire study period. The coefficient of variation (CV) for export quantity rose from 37.82 per cent in Period I to 40.99 per cent in Period II, eventually reaching 53.47 per cent for the entire period, demonstrating higher variability over time. In terms of export value, the CV fell from 60.79 per cent in Period I to 38.56 per cent in Period II, with an overall CV of 79.43 per cent.

The export price had a CV of 39.10 per cent in Period I and declined to 16.92 per cent in Period II, for a total variance of 48.04 per cent.

The CDVI for export quantity increased from 23.36 per cent in Period I to 27.69 per cent in Period II, for a total gain of 27.86 per cent. Similarly, export value had CDVI values of 16.73 and 12.24 per cent in Periods I and II, for a total value of 18.80 per cent. The export price exhibited positive CDVI values of 16.12% in Period I and 14.46% in Period II, for a total CDVI of 16.95%. Overall, positive CDVI levels suggest consistent growth in quantity, value and price, whereas CV data show volatility in export performance

Period wise instability in export of green chilli from India

Table 3 presents the country-wise instability in India's green chilli exports in terms of quantity, value and export price for Period I and Period II. The results indicate considerable variation among the major

destination countries.

Table 2. Instability in Green Chilli Export from India, Period I (2005-06 to 2014-15), Period II (2015-16 to 2024-25), Overall Period (2005-06 to 2024-25)

Particular	Quantity (MT)			Value (₹ /Lakhs)			Price (₹ / Kg)		
	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period
	I	II		I	II	Period	I	II	
CV (%)	37.82	40.99	53.47	60.79	38.56	79.43	39.10	16.92	48.04
CDVI (%)	23.36	27.69	27.86	16.73	12.24	18.80	16.12	14.46	16.95

Table 3. Period wise Instability in Export of Green Chilli from India, Period I (2005-06 to 2014-15), Period II (2015-16 to 2024-25)

Sr. No	Country	Export Quantity		Export Value		Export Price	
		Period I	Period II	Period I	Period II	Period I	Period II
		I	II	I	II	I	II
1	UAE	25.55 (35.35)	6.37 (22.58)	17.29 (50.87)	10.35 (36.65)	18.26 (37.75)	4.79 (16.64)
2	Bangladesh	129.33 (129.42)	106.41 (110.37)	121.40 (123.32)	112.55 (116.91)	25.92 (33.50)	13.38 (13.52)
3	Qatar	42.58 (155.48)	30.60 (32.55)	48.51 (181.66)	31.84 (41.93)	21.17 (23.53)	7.18 (17.54)
4	Oman	54.27 (118.34)	37.84 (40.89)	59.47 (150.19)	34.64 (44.69)	38.58 (40.71)	21.84 (29.85)
5	UK	33.29 (73.36)	23.72 (60.90)	42.70 (121.30)	25.75 (47.50)	45.74 (54.91)	7.75 (22.36)
6	Bahrain	27.30 (29.44)	25.34 (26.20)	52.19 (71.31)	29.61 (34.31)	32.30 (43.80)	9.60 (25.75)
7	Kuwait	66.77 (73.21)	77.57 (135.84)	72.64 (90.99)	83.94 (168.35)	30.86 (48.20)	33.43 (56.49)
8	Nepal	36.65 (38.36)	49.91 (56.70)	38.09 (47.09)	59.19 (66.79)	25.44 (51.43)	23.93 (24.17)
9	USA	42.64 (52.64)	37.42 (37.59)	40.84 (57.55)	30.32 (36.24)	46.46 (51.42)	6.17 (21.58)
10	Others	84.01 (121.54)	33.18 (63.87)	74.22 (137.11)	36.57 (54.86)	16.59 (28.11)	44.27 (47.59)
	Total	23.36 (37.82)	27.69 (40.99)	16.73 (60.79)	12.24 (38.56)	16.12 (39.31)	14.46 (16.92)

(Note - Bracket values represent CV)

In terms of export quantity, Bangladesh recorded the highest instability in both Period I and Period II, with values of 129.33 and 106.41 per cent, respectively, whereas the UAE showed comparatively lower instability. For export value, Bangladesh again registered a high level of instability, while Bahrain and the UAE experienced relatively lower fluctuations during Period II. Kuwait recorded a substantial increase in instability in both export quantity and value during Period II, indicating greater fluctuations in exports to this market.

In terms of export price volatility, the United Kingdom shown relatively significant volatility during Period I, while Kuwait saw the most price volatility among the selected nations during Period II. Between the two eras, total exports' overall volatility grew from 37.82 to 40.99 per cent in quantity, but export value instability decreased from 60.79 to 38.56 per cent. Similarly, export price volatility dropped significantly from 39.31 to 16.92 per cent. Overall, the findings suggest that the level of volatility varies significantly among des-

tination markets and export indicators, with quantity and value fluctuating more than export price in numerous countries.

Country wise instability in export of green chilli from India

Table 4 showed the country-specific instability and increase in India's green chili exports using CV and CDVI. Bangladesh had the highest CV for export quantity (161.23%) and a high CDVI (124.75%), indicating significant fluctuation and strong growth. Kuwait experienced the most volatility in export value, with a CV of 214.65% and a CDVI of 191.53%. Kuwait had the highest export price CV (77.50%), while the "Others" category had the highest CDVI (44.66%). The UAE and Bahrain experienced relatively minimal variations in export quantity and pricing. Overall, the CV values were 53.47, 79.43, and 48.04 per cent for quantity, value and price, respectively, with corresponding CDVI values of 27.86, 18.80 and 16.95 per cent. The findings show that export value suffered the most volatility, while export quantity witnessed the largest overall growth.

Table 4. Country wise Instability (CDVI %) and (CV%) in Export of Green Chilli from India, (2005-06 to 2024-25)

Sr. No.	Countries	Export Quantity		Export Value		Export Price	
		CV (%)	CDVI (%)	CV (%)	CDVI (%)	CV (%)	CDVI (%)
1	UAE	32.75	21.53	75.19	18.33	52.08	13.57
2	Bangladesh	161.23	124.75	175.59	125.92	26.86	19.97
3	Qatar	90.93	39.21	105.67	37.22	45.79	17.97
4	Oman	100.76	53.55	112.01	47.64	58.57	30.45
5	UK	67.81	62.46	87.10	57.03	64.15	25.97
6	Bahrain	39.68	29.95	80.76	33.42	59.78	19.83
7	Kuwait	121.07	119.42	214.65	191.53	77.50	34.52
8	Nepal	55.26	50.96	74.37	54.86	38.28	30.05
9	USA	46.73	46.20	62.79	37.50	59.68	27.02
10	Others	124.95	123.91	92.24	64.47	79.51	44.66
	Total	53.47	27.86	79.43	18.8	48.04	16.95

Conclusion

India's green chilli exports showed a strong overall growth during 2005–06 to 2024–25 increased significantly in volume, value and price. Period-wise analysis revealed significant changes in export quantity, value and price. Bangladesh and Kuwait experienced especially high levels of country-wise instability. Kuwait had the most volatility in export value and price, while Bangladesh had the most volatility in export volume. Despite these changes, India's green chili exports increased significantly in international markets. The findings emphasize the importance of market diversity and improved risk management in order to reduce export volatility.

Suggestions

1. To minimise the instability brought on by reliance on a small number of foreign markets,
India should diversify its export destinations.
2. To determine the causes of variations in export quantity, value and price, particular focus should be placed on extremely volatile markets like Bangladesh and Kuwait.

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Authors

Zimare MD

M. Sc. Scholars, Division of Agricultural Economics, Govt. College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

JS Kumbhar

Assistant Professor of Agriculture Economics, Division of Agriculture Economics, Govt. College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

TB Deokate

Assistant Professor of Agriculture Economics, Division of Agriculture Economics, Govt. College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

YC Sale

Professor, Division of Agricultural Economics, Govt. College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AA Bhagat

Assistant Professor of Statistics, Division of Agriculture Economics, Govt. College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

PV Munde

Assistant Professor of Agriculture Economics, Division of Agriculture Economics, Govt. College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AK Shinde

M. Sc. Scholars, Division of Agricultural Economics, Govt. College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India