



Production, Export and Price Behavior of Fenugreek in India

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Abstract: The area under fenugreek cultivation has shown an undulating trend in India in the last two decades. There are various price and non-price factors that play a role in determining the area under a crop. This study analyzed the area, production, productivity and export of fenugreek in India from 1980-81 to 2020-21, using exponential growth function and instability analysis. Daily market prices and arrivals in major markets in Rajasthan, Gujarat and Madhya Pradesh were analysed employing the central moving average from 2007 to 2021. Multiple linear regression was employed to determine the influence of price on its area. The fenugreek production and export increased at CAGR of 5.37 and 7.37 percent per annum, respectively. Productivity was comparatively more consistent than area and production. Prices in studied markets increased significantly. A negative correlation between prices and arrival was observed. There was a significant influence of producer prices on the area harvested. Price and export promotion policies will encourage farmers to put the additional area into the cultivation of fenugreek.

Fenugreek (*Trigonella foenum-graecum* L.), a native of South-Eastern Europe and West Asia, is an annual leguminous herbaceous seed spice from the *Fabaceae* family (Pal, & Mukherjee, 2020). The Indian sub-continent is thought to be its secondary centre of origin (Petropoulos 2002). The genus *Trigonella* consists of more than 50 species (Kakani & Anwer 2012). Two cultivated species of genus *Trigonella* viz. *foenum-graecum* (commonly known as fenugreek) and *corniculata* (commonly known as pan methi or *Kasuri* methi) are economically cultivated seed spices in tropical as well as temperate regions of India (Meena et al 2021). Mainly it is grown during the winter season but in South India is also grown as a rainy-season crop. Currently, it is commercially cultivated in parts of the United States, Canada, Argentina, North Africa, Mediterranean Europe, the Middle East, South Asia, China, and Australia for its seeds, tender shoots, and fresh leaves (Basu et al 2019). In India, it is cultivated on large scale with upward trend in area between 1980 to 2014-15, but its cultivation shows a downward trend since 2015-16, which needs attention. Many factors are responsible for shrinkage, but the prices of the commodity in question play a pivotal role (Singh 2012, Meena et al 2021). An integrated marketing system of a commodity following the law on one price also determine the efficient allocation of scarce resources needs to be analysed in this crop (Easwaran and Ramasundaram 2008, Trivedi and Nair 2018). Keeping all this background in view, the present study was taken to explore the dynamics of prices of fenugreek across spatially distinct markets and also at different periods in India.

MATERIAL AND METHODS

The present study is based on time series data on area, production, export, daily market prices and arrivals. To analyze production and export dynamics during 1980-81 to 2020-21, information on area, production and export was compiled from Spice Board India and other sources. For comparison whole period was divided into two sub-period i.e. period I (1980-81 to 2000-01) and period II (2001-02 to 2021-22). Growth and instability were measured to check acreage and production performances during two sub and the overall period (Meena et al, 2018) following the methodology suggested by Chand et.al. (2011).

Growth rate analysis: The compound growth rate (CGR) in the area, production, and export from India was computed using the formula:

$$Y_t = ab^t e^{u_t}$$

Where,

Y_t = Area/ Production/ Productivity/ Export in year 't'

a = Intercept, b = (1+g) regression coefficient, t = Time period in years

u_t = Disturbance term for the year 't'

Taking natural log on both sides equation (1) becomes

$$\ln Y_t = \ln a + t \ln b + u_t$$

$$\text{Growth rate} = (\text{Antilog of } b - 1) * 100$$

Instability analysis: The variations from the trend in area, production, productivity and export were estimated using the Instability Index.

Instability Index = Standard deviation of the natural logarithm (Y_{t+1}/Y_t)

Where,

Y_t = Area / Production / Productivity and export in current year 't', and

Y_{t+1} = Area / Production / Productivity and export in next year 't+1'.

If the series swings more over the trend, the ratio of Y_{t+1}/Y_t also fluctuates more, and the standard deviation increases indicating higher instability among variables.

To study seasonality and variations in fenugreek prices information on daily market prices and arrivals information in major markets (based on higher arrivals) were compiled from the Agmarknet website (<https://agmarknet.gov.in>) during January 2007 to June 2021 (174 months). Based on the arrivals in tons, major markets in Rajasthan (Kota and Nimbahera) Gujarat (Rajkot and Patan) and Madhya Pradesh (Mandsour and Neemach) were chosen to study seasonality and variations in price and arrival were computed using Central Moving Average Method (CMA) and Seasonality Index as used by Makama (2016) and Meena et al (2021). CMA eliminates seasonality and randomness and represents the trend and cyclical components of the original series. CMA was estimated using the following formula.

$$CMA_t = \sum \frac{P_i}{n}$$

$$i = t-1/2(n-1)$$

Where: CMA = Central Moving Average, P_i = Nominal price, n = number of periods

Seasonality represents the ratio of the price each month to the average annual price. Seasonal index (SI) can then be written as:

$$SI = TCSE_i / TC_i = SE_i = (P_i / CMA_i) * 100$$

$$GSI = SI * 1200 / \sum_{i=1}^{12} SI$$

SI = is the average seasonal index for a month i

Market integration in selected fenugreek markets was analyzed using time series analysis i.e. Unit root test (ADF and Philip Pheron test), Johnsons cointegration test, Granger causality test and Vector Error Correction Model (Richard et al 2016).

Cost and returns analysis: A primary survey of thirty farmers from Jhunjhunu district of Rajasthan was carried out during 2021-22 and cost and returns in fenugreek cultivation were calculated. Variable costs including the value of hired human labour, owned or hired machinery, seed (both farms produced and purchased), insecticides and pesticides, manure (owned and purchased), fertilizer, irrigation charges, and interest on working capital were calculated. Profit was worked out by subtracting cost plus the imputed value of family labour charges from the gross value of output.

Influence of prices on its acreage: In analyzing the influence of market price on its area multiple linear regression analysis was employed.

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + u$$

Where,

Y = Fenugreek area in current year (t)

a = Intercept, a scale parameter

X_1 = Fenugreek price in current year (t)

X_2 = Fenugreek price in lag year (t-1)

X_3 = Fenugreek export in lag year (t-1)

b_i = Regression co-efficient of the respective independent variable.

RESULTS AND DISCUSSION

Fenugreek cultivation in India: Fenugreek is the third largest grown seed spice in India next to cumin and coriander. During 2021-22, it was cultivated under 1.67 lakh ha, producing 2.48 lakh tons of fenugreek seeds at average productivity of 1482 kg ha⁻¹ (Adv. Est. Spice Board India, 2022). Its area and production from 1980-81 to 2021-22, increased by more than three and six times, at a compound growth rate of 4.55 and 5.37 percent, respectively (Fig. 1). Rajasthan ranks first in its area (90469 ha) and production (110869 tones) with 54 and 45 percent share to national area and production respectively. In Rajasthan, major fenugreek growing districts are Sikar, Chittorgarh, Jaipur, Pali, and Jhalawar. Madhya Pradesh ranks second followed by, Gujarat, West Bengal, Uttaranchal and Haryana in fenugreek cultivation. Integrated nutrient management in low fertile belts, adopting high-yielding varieties and management of biotic and abiotic stresses increased its productivity in the country (Lal et al 2017). During the study period, productivity improved from 900 kg ha⁻¹ in 1980-81 to 1187 kg ha⁻¹ in 2000-01, and a further 1482 kg ha⁻¹ in 2021-22. The multiplicative effect of area and productivity resulted in production reached to 310 thousand tons in 2017-18. In India, fenugreek cultivation became more popular in the last two decades. From 1980 to 2000 (sub-period I) area and production expanded at less than one percent CGR. Area ranged from 25 to 45 thousand ha and production ranged from 21 to 57 thousand tons. Its export demand both in volume and value term increased faster in the above period. After 2000, its area and production increased at CGR of 7 and 8 percent, respectively (Table 2).

Fenugreek export from India increased faster than their production throughout the period, indicating increasing overseas demand. In quantity and value term export increased at CGR of 7.37 and 14.88 percent per annum, respectively.

Cost and returns in fenugreek cultivation: To analyze profitability in fenugreek cultivation, a primary survey of thirty farmers from Jhunjhunu districts was carried out using pre-structured questionnaires. The average cost A2 including

family labour was calculated at 34041Rsha⁻¹. Return per rupee cost was more than two rupees in fenugreek cultivation during 2021-22 in the survey area (Table 3).

Price dynamics: Prices trends in major fenugreek markets namely Kota, Nimbahera in Rajasthan, Patan and Rajkot in Gujarat and Mandsour and Neemach in Madhya Pradesh were analyzed (Fig. 2). Fenugreek seed prices in surveyed markets ranged from Rs. 1776 in May 2007 to Rs. 7543 in Oct. 2015 per 100 kg. The average price in Madhya Pradesh markets namely, Neemach, and Mandsour prevailed higher than Gujarat and Rajasthan (Table 3).

From 2007 to 2021, fenugreek prices show an increasing trend till September 2015 later decreased up to September 2017 again bounced back. In the overall period, it increased at CGR of 0.33 to 0.45 percent per annum. The highest growth in prices was measured in Nimbahera followed by Neemach and Mansour. Intra-year coefficient of variation measures variability in the prices of agricultural commodities (Sharma & Kumar 2001). Average intra-year variation was low in Madhya Pradesh markets (9.79%) than in Rajasthan (10.71) and Gujarat (10.77%; Table 4). The highest growth in fenugreek prices with the lowest variation resulted in the highest arrivals of fenugreek seeds at Mandsour markets followed by Neemach. Similar findings were also reported by Meena et al (2021).

There was a significant increase in monthly prices in (Table 5). The highest increase per month was in Nimbahera, followed by Neemach and Mandsour. A

negative correlation coefficient between prices and arrivals in Kota resulted in a significant decrease in arrivals during the study period in this market. The positive correlation coefficient between prices and arrivals at Neemach,

Table 3. Cost and returns in fenugreek cultivation during 2021-22

Particulars	Physical unit	Cost/returns Rs ha ⁻¹
Land preparation	2-3 times	3766.03
Seed cost	12-14 kg ha ⁻¹	846.15
Sowing cost	ha ⁻¹	1698.72
Irrigation cost	3-5 times	5248.4
Plant protection chemicals	0-2 spray	3076.92
Intercultural operation	1-2 times	7339.74
Harvesting cost	17.27 may days ha ⁻¹	8637.82
Threshing cost	2 Hrsha ⁻¹	2275.64
Interest on working capital	7%	1151.13
Variable cost including family labour	Rsha ⁻¹	34040.55
Seed yield	kg ha ⁻¹	1139.42
Price received	Rs qtl ⁻¹	6008.00
Gross value of produce	Rsha ⁻¹	68456.50
Return over cost A2+FL	Rsha ⁻¹	34415.95
Return per rupee operational cost		2.01

Source: Calculated from the cost of cultivation survey conducted by authors.

Table 1. Major fenugreek growing states and districts in India 2021-22

State	Area (ha)	Production	Major districts
Rajasthan	90469 (54.02)	110869 (44.67)	Bikaner, Sikar, Jodhpur, Pratapgarh, Churu, , Jhunjhunu and Nagaur
Madhya Pradesh	52234 (31.19)	101882 (41.05)	Ratlam, Ujjain, Mandsaure, Neemuch, Rajgarh, Shajapur, Guna, Dhar , Sehore,
Gujarat	8702 (5.20)	16697 (6.73)	Mehasana , Banaskatha
India	167468 (100)	248203 (100)	

Source: Spice Board India, 2022 for area and production for major districts. The figure in parenthesis presents the percent share to India's total

Table 2. Growth and instability analysis in Fenugreek production and export from India; 1980-81 to 2020-21

Particulars	Sub-period I		Sub-period II		Overall period	
	CGR (%)	Instability index	CGR (%)	Instability index	CGR (%)	Instability index
Area (ha)	0.33	0.32	6.74	0.32	4.55	0.32
Production (Tones)	0.75	0.34	7.81	0.33	5.37	0.33
Productivity (Kg ha ⁻¹)	0.42	0.20	1.00	0.09	0.79	0.15
Export (Tones)	10.38	0.41	7.90	0.38	7.37	0.39
Value (in lakh rupees)	21.22	0.35	15.10	0.33	14.88	0.34

Source: Estimated from data compiled from Spice Board, India

Nimbaheda and Rajkot resulted in a significant increase in arrivals in above markets. The highest significant increase in arrivals was estimated in Neemach followed by Nimbaheda and Rajkot.

Impact of price on area: Unfavorable market prices from 2015 onward resulted in the shrinkage of fenugreek acreage by more than 60 thousand ha till 2021-22 consequently decreasing production in recent years. The price of a

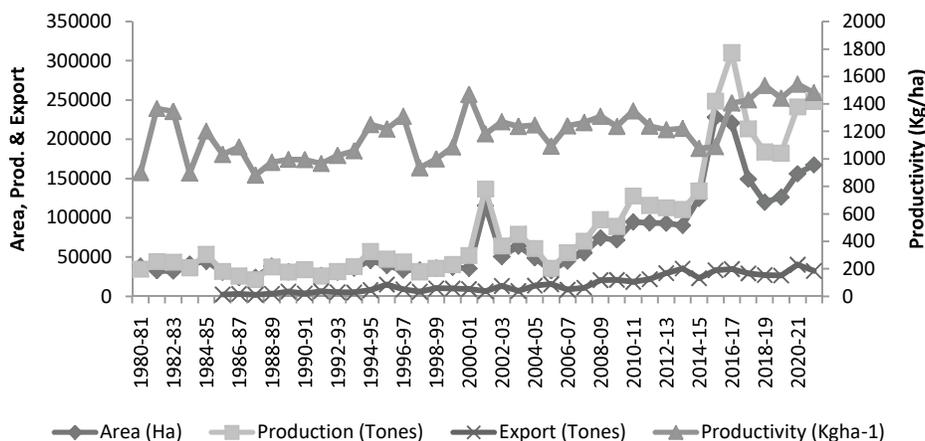


Fig. 1. Area (ha), production (tonnes), productivity (Kg ha^{-1}) and export of fenugreek in India during 1980-81 to 2021-22

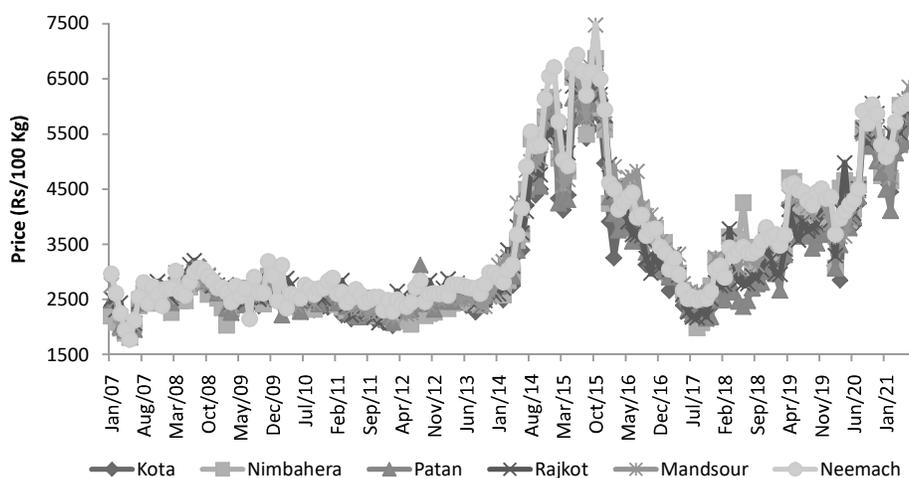


Fig. 2. Fenugreek price in major markets from Jan. 2007 to June 2021

Table 4. Descriptive statistics of monthly fenugreek prices (Rs per 100 kg) from January 2007 to June 2021

Particulars	Rajasthan		Gujarat		Madhya Pradesh	
	Kota	Nimbahera	Patan	Rajkot	Mandsour	Neemach
Mean	3168.49	3358.14	3210.71	3378.33	3456.28	3540.97
Median	2685.63	2801.88	2732.29	2841.03	2896.19	2972.97
Minimum	1941.19	1810.53	1940.42	2047.78	1871.00	1776.50
Maximum	6541.71	6869.57	6796.32	6598.91	7475.42	7542.80
CGR	0.38	0.45	0.33	0.36	0.42	0.42
Instability index	0.09	0.10	0.10	0.09	0.08	0.09

Source: Calculated from daily market prices harvested from agmarknet.

Table 5. Intra year coefficient of variation in fenugreek price

Year	Kota	Nimbahera	Patan	Rajkot	Mandsour	Neemach
2007	9.39	12.57	12.73	9.99	13.27	13.97
2008	7.52	6.98	7.67	6.89	5.23	5.80
2009	5.67	9.29	7.65	7.57	3.81	9.23
2010	4.69	8.45	5.42	6.97	4.60	7.46
2011	4.54	5.11	4.87	9.50	6.30	5.36
2012	7.16	6.44	9.63	5.79	5.65	5.85
2013	4.64	5.66	3.60	5.50	3.37	4.50
2014	27.82	29.92	25.35	23.77	22.54	28.72
2015	13.95	11.67	14.53	7.24	13.83	11.76
2016	10.08	8.93	10.67	16.19	9.79	8.55
2017	9.70	15.87	13.48	15.67	11.35	10.75
2018	7.51	10.72	8.94	10.06	6.27	6.56
2019	9.34	10.32	10.30	10.41	7.55	8.85
2020	20.63	16.68	17.92	17.84	18.19	17.20
2021	10.04	10.18	11.33	5.82	10.40	7.00

Source: Calculated from daily market prices harvested from agmarknet.

Table 6. Trends in monthly price, arrivals and correlation between arrivals and prices of fenugreek; 2007 to 2021

Market name	Price trend	Arrival trend	Correlation coefficient
Kota	2063.95+12.62*** (t)	976.62-3.64***(t)	-0.27
Nimbahera	2020.44+15.29***(t)	68.55+1.72**(t)	0.36
Patan	2231.27+11.19**(t)	81.99-0.16(t)	0.00
Rajkot	2237.88+13.03**(t)	249.52+1.48*(t)	0.11
Mandsour	2157.30+14.85***(t)	1336.13+0.94(t)	-0.19
Neemach	2228.41+15.00***(t)	-27.33+13.83***(t)	0.25

Source: Estimated from daily market prices harvested from agmarknet

Table 7. Results of multiple linear regression; Dependent variable fenugreek area in India

Particulars	Coefficients	Standard error	t Stat	P-value
Intercept	-20804.23	14454.61	-1.44	0.18
Price in current year (Rs/100 kg)	-32.76***	5.74	-5.71	0.00
Price in lag year (t-1;Rs/100 kg)	48.73***	5.37	9.08	0.00
Export in lag year (t-1; tons)	3.73***	0.65	5.77	0.00
Adjusted R Square		0.91		

*** indicates significance at 0 percent level of significance

commodity directly influences its acreage (Abu, 2017). Multiple linear regression was employed to measure the impact of its price in the current as well as the lag year (t-1) and last year's export volume on acreage in current year. More than 90 percent variation in the fenugreek area in the country is significantly determined by its prices and export demand. A unit increase in lag year price and export demand increases its acreage by 49 and 4 hectares respectively, keeping other things constant (Table 5). A significant negative response of current year price indicates higher harvest leads

to prices crash in a particular year. Similar results were also obtained by Mekbib et al (2016) in wheat, corn, soybeans and rice at the global level too.

CONCLUSION

During 2080-81 to 2020-21, fenugreek production in India increased faster due to the combined effect of an increase in acreage and a productivity improvement. The significant increase in its prices coupled with increasing export demand for its seeds has played a pivotal role in its area expansion.

The markets with a negative correlation coefficient between monthly arrivals and prices have reported decreased arrivals over the period, significantly. On the other hand market with a positive correlation registered a significant increase in arrivals over the study period. The study suggests the need for price support and export promotion policies in fenugreek for further area expansion in the country.

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