

Fennel-growth story in India

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Abstract

India is a leading producer and exporter of fennel. The demand for fennel is increasing as the awareness of its medicinal benefits is gaining grounds. This paper attempts to understand the production and demand for Indian Fennel. We have also tried to empirically measure the growth trend of fennel production and its export from India. The calculation of instability index respective variables helps us to understand the crux of challenges for fennel in India. Few case studies are also included to show how continuous research are improving the volume and quality of fennel production. The paper concludes with progressive suggestions.

1. Introduction

Fennel holds a ubiquitous position in an average Indian household. The awareness of general benefits has passed from generations to generations. Fennel (*Foeniculum vulgar* Mill.) is one of the oldest aromatic and medicinal plants of the Apiaceae family which is native of southern Europe and the Mediterranean region but it has wild growing in France, Spain, Portugal, and North Africa (Miraldi, 1999). Fennel is mainly cultivated in India, Japan, China, Brazil, Argentina and Turkey (Kalleli, et al, 2019). This paper is an attempt to understand the production pattern of fennel in India, its' demand globally and then derives the challenges and trends of growth prospects.

The entire paper is organised as follows. The next section talks about the history of the name fennel, usage of the plant and research on economic value of the plant. Section 3 gives an overview about the cultivation of fennel across States and whole of India, section 4 highlights the global standing of India. In section 5 we have empirically calculated the trend and instability index for area under cultivation, volume of fennel produced and revenue earned from fennel exports in India over the period 2006-07 and 2022-23. Section 6 discusses about current research going on with regard to fennel cultivation and section 7 draws the conclusion.

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2. Literature Review

Fennel belongs to the flowering plant species, umbellifers. Fennel is a hardy, biennial, perennial herb with yellow flowers and feathery leaves (Singh, 2017). The botanical name of fennel / saunf is 'Foeniculum vulgare Miller', family name is 'Apiaceae'. The name *Foeniculum vulgare* must be accredited to Philip Miller, who first validly published it in the eighth edition of his "Gardeners Dictionary" in 1768. From then on, the name of this plant is written as *Foeniculum vulgare* Mill (Badgujar, 2014).

Fennel has been there since ancient times Greek name for fennel is 'Marathon', meaning 'something that has been there for long'. The name Marathon is also derived from the Greek Persian war fought in the ground of Marathon where fennel was growing in abundance. Greek mythology also has a story in which Prometheus smuggled fire to humans in the hollow wand of fennel stalk. Pliny the Elder (Gaius Plinius Secundus), Roman author and naturalist has also expressed his faith in medicinal properties of fennel. Charlemagne, Frank of the Eastern Frankship kingdom, made fennel an essential vegetable in every imperial garden. Medieval times saw fennel as being used as a protection against witchcraft. Chewing fennel has also been observed during worship services by puritans and also to keep away hunger during fasts.

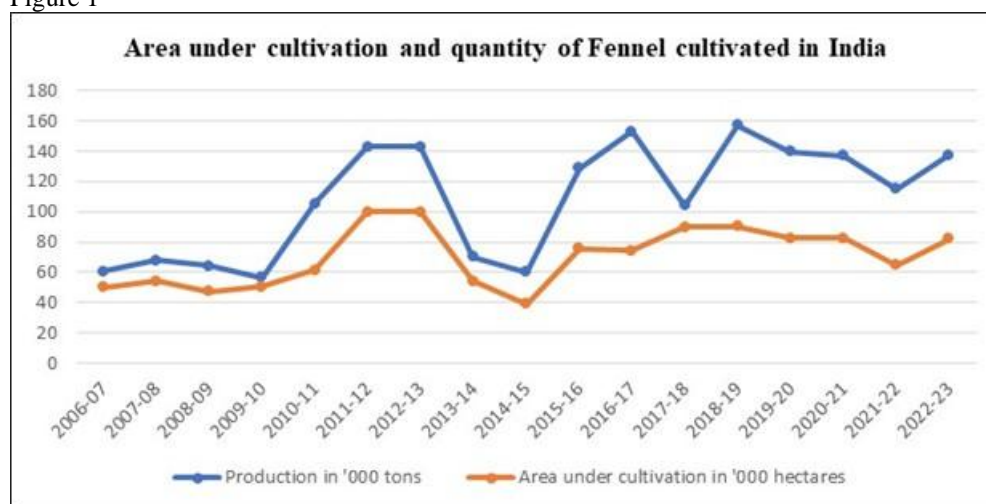
Fennel crop is ready for harvest in almost six months. All parts of this important plant is useful, either for culinary or medical purposes. It's vegetable, flowers, leaves, seeds, pollens all have distinct qualities and usage. Fennel is an important medicinal and aromatic plant used as a carminative, digestive, lactagogue and diuretic and in treating respiratory and gastrointestinal disorder (Valduga et al, 2019). The market demand for fennel and its derived products has been increasing due to its culinary and medicinal applications. The leaves of fennel are used for garnishing. Leaves and stalks are used in salads. It is an essential ingredient in Italian sausages, widely used to sprinkle on pizza. Dried seeds have fragrant odour and pleasant aromatic taste and therefore used as a masticatory. It is also used for flavouring soups, meat dishes, sauces, pastries, confectionaries and liquors. The seeds are aromatic, stimulant and carminative. Fennel seeds are used in the preparation of various dishes, desserts, and beverages. The essential oil extracted from fennel is used in the pharmaceutical, perfume, and food industries (Khan et al, 2022). Fennel, like other medicinal plants, has antibacterial and antibiotic properties that may help to reduce the quantity of unwanted intestinal microorganisms and improve digestion (Elgayyar, 2001). With its export potential, fennel farming can be a profitable venture for farmers in India.

3. Fennel Cultivation across India

Indian fennel seeds are known for their high quality and distinct aroma. This superior quality is attributed to unique climatic conditions and soil properties in India, which are conducive to fennel seed cultivation. Thus, Indian fennel seeds are highly sought after by chefs, food manufacturers and consumers looking for premium quality fennel seeds.

Both quantity of fennel cultivated and area under fennel cultivation has increased for India from 2006-07 to 2022-23. One can observe figure 1 for the graphs of both. However, there has been good amount of fluctuations also as both blue and orange line is showing from its up and down curvatures.

Figure 1



Data Source: Report of Spices Board, Government of India

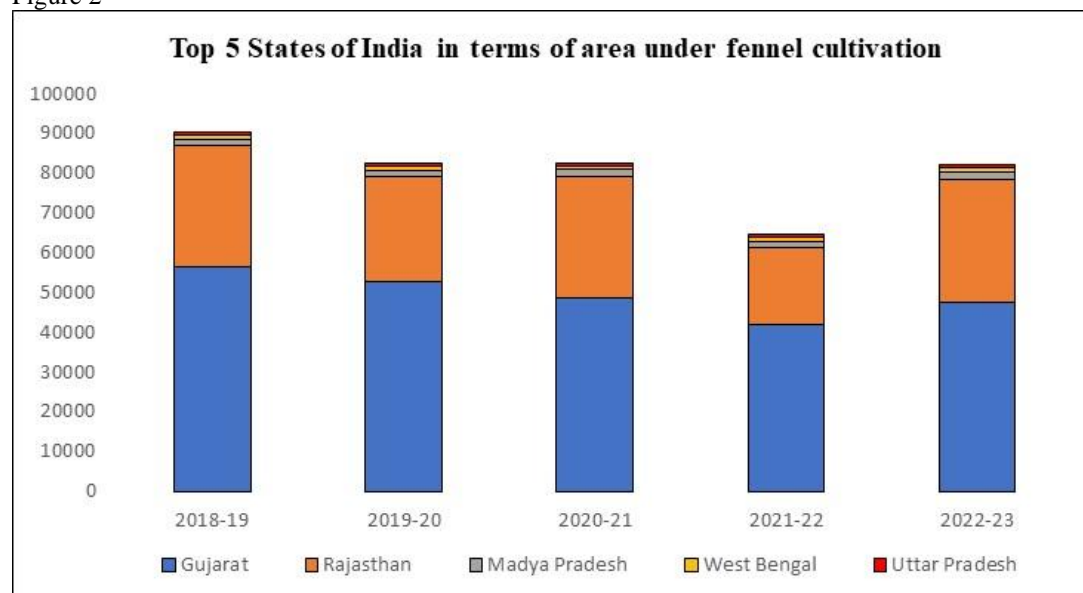
The top five fennel seed-producers in India are Gujarat, Rajasthan, Madhya Pradesh, West Bengal and Uttar Pradesh. Figure 2 and figure 3 shows the distribution across these five states from 2018-19 to 2022-23 with regards to area under cultivation of fennel and amount of fennel produced respectively. We observe that Rajasthan and Gujarat are the leading fennel-producing States in the country, contributing about 96% of the total production. Gujarat ranks first in fennel production, producing more than 90,000 tons and utilising around 45,000 hectares (Sable, et al. 2022).

In Rajasthan, it is mainly cultivated in Nagaur, Sirohi, Jodhpur, Pali and Swai Madhopur districts and in Gujarat the major fennel growing area are Mehasana, Morbi, Banaskatha, Sabarkantha and Aravalli. The total area of fennel cultivation in Gujarat has reached 68,600 hectares, a substantial increase from 34,000 hectares in the previous year. This 101.76 percent growth in sowing area indicates a significant upsurge in fennel cultivation across the state. In Rajasthan, the highest amount of fennel is cultivated in Nagaur district, covering 10,000 hectares. Gujarat is known for its high-yielding varieties like 'Gujarat Fennel 1' and 'Gujarat

Fennel 12' (Bairwa, et al, 2022). In both these states, the reason for high production is favorable climate and soil conditions, required for the growth of this aromatic herb.

Gujarat Fennel-11 is a bold seeded variety and is peculiar on three counts (i) the first variety recommended for rabi cultivation in the State, (ii) synchronous flowering habit and (iii) late heat tolerance. It possesses a greater number of seeds, umbellates/ umbel and more numbers of umbels/plant. On an average it gave 2489 kg/ha yield that is 12 per cent higher than the extant variety GF-2. Cultivation of Gujarat Fennel 12 (GF-12) will not only enhance the productivity but also improve profitability of fennel under varying environmental conditions. This variety has been recommended for release at national level during the biannual workshop of AICRP (All India Coordinated Research Projects) on spices held at Coimbatore (Gondalia, et al, 2019).

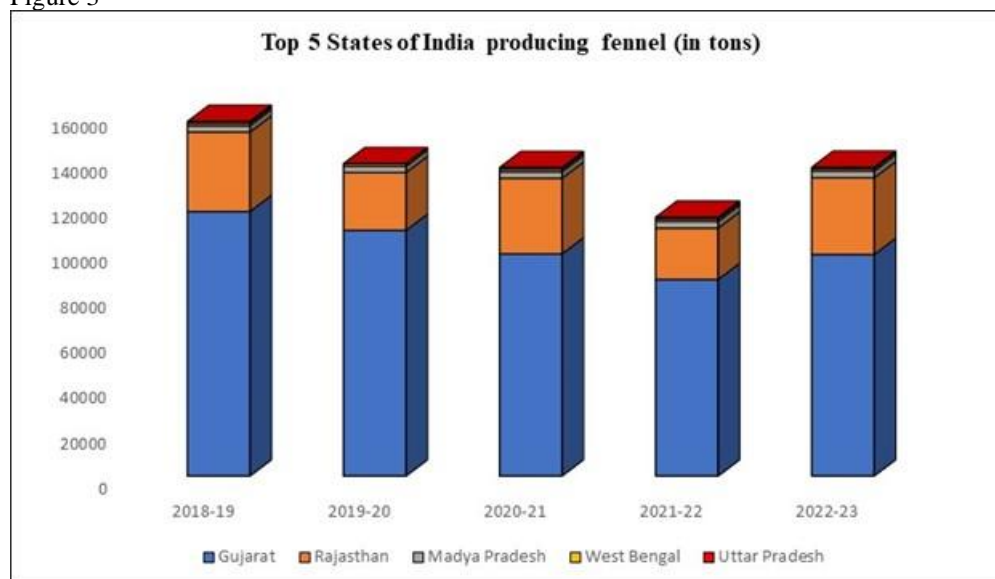
Figure 2



Source: Report of Spices Board, Government of India

Fennel cultivation has increased across all four major producing regions in Gujarat, with the most notable increases observed in Kutch, Central Gujarat, and Saurashtra (CNB News, 2023). This has been due to favorable conditions and encouraging market prices. This growth in the agricultural sector is a significant development for the state's economy and for the farmers engaged in fennel cultivation.

Figure 3

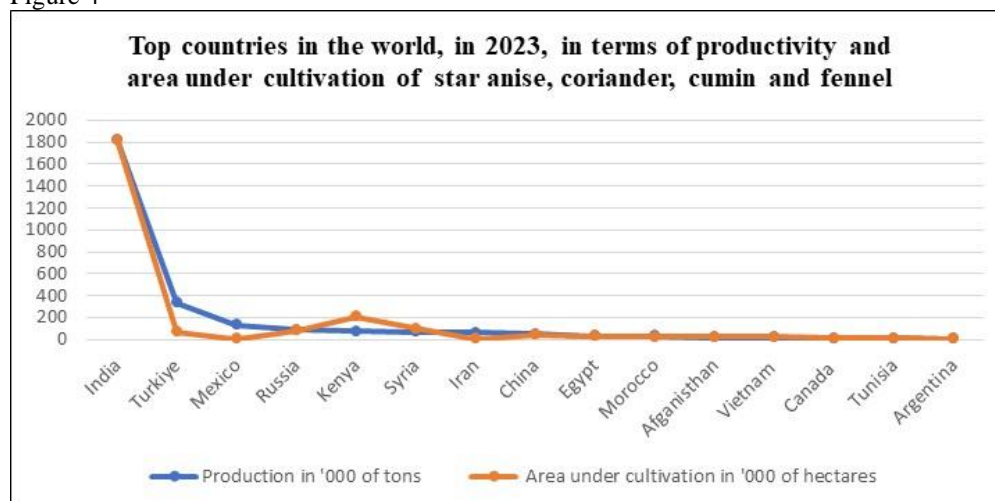


Source: Report of Spices Board, Government of India

4. Global Demand for Fennel cultivated in India

Global fennel production data showing each of the countries producing this commodity is not available. According to world statistical data, fennel production status data are not given alone, but are given as the sum of anise, star anise, fennel and coriander data. This is presented in figure 4. It clearly shows India as the largest producer of spices in the world.

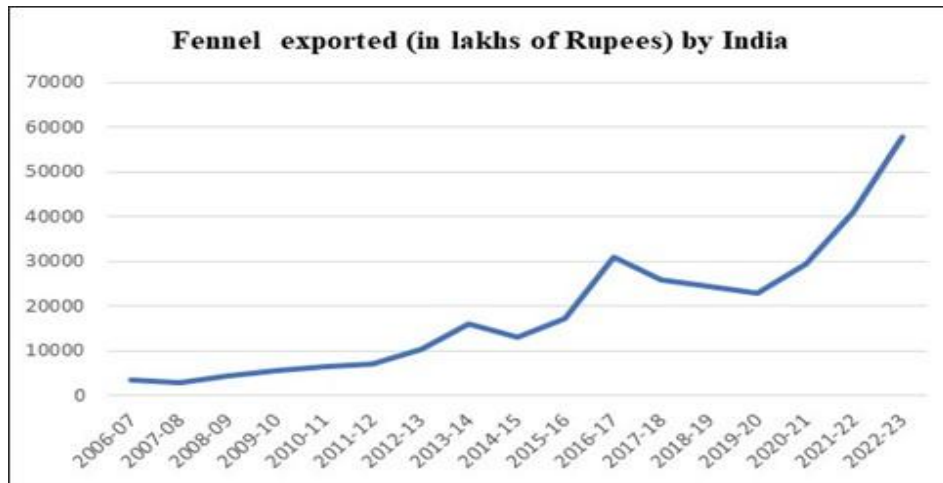
Figure 4



Data Source: FAO 2023

There has been ever increasing demand of seed spices and importing countries consider India as consistent source. No other country in the world has such a broad supply base of seed spices. This is evident from figure 5 which shows that the value of fennel exported by India has increased from 2006-07 to 2022-23. It augmented from Rs 3580 lakhs in 20026-07 to Rs 57660 lakhs in 2022-23.

Figure 5



Data Source: Spices Board, Government of India

5. Growth trend and instability index for fennel cultivated in India

Now, in order to find out the trend line for quantity of fennel produced, area under fennel cultivation and export revenue earned by India from fennel, we have considered the following semi-log model:

$$\log Y = \beta_1 + \beta_2 t + \epsilon$$

We have considered three separate regressions, based on different Y in each one. Model I is having area under fennel production in India as the dependent variable, Model II has quantity of fennel produced in India as dependent variable and in Model III, the dependent variable is export revenue earned by India from fennel. In all three models, t is time period from 2006-07 to 2022-23. The regression results are given in table 1. We have also calculated the compound growth rate (CGR) and Cuddy Della Valle Instability (CDV) Index for area, production and export revenue of fennel and the respective values are given in table 2.

$$CGR = 100(\text{Antilog} \hat{\beta}_2 - 1)$$

$$CDV \text{ Index} = CV \sqrt{1 - \bar{R}^2}$$

where CV is the coefficient of variation and \bar{R}^2 is the adjusted R^2 . The following tables show the regression results, calculated CGR and CDV Index.

Table 1

Model	Dependent Variable	Intercept	Time	R^2	CGR%
I	Area under fennel cultivation	— 54.73**	0.028**	0.264**	2.9
II	Quantity of fennel cultivated	— 97.5***	0.05***	0.447***	5.2
III	Export revenue from fennel	— 340.04***	0.174***	0.943***	18.9

p<0.05, *p<0.01

Table 2

Variable	$\overline{R^2}$	CV	CDV Index	Decision
Area under fennel cultivation	0.184	27.336	24.686	Medium Instabilty
Quantity of fennel cultivated	0.387	34.413	26.950	Medium Instabilty
Export revenue from fennel	0.815	80.206	34.431	High Instability

From table 1 we observe that area under fennel cultivation has grown at the rate of 3 percent per year, while volume of fennel cultivated has grown at the rate of 5 percent per year and growth rate of export revenue from fennel was 19 percent approximately. All the estimated growth rates are significant. Table 2 shows that Cuddy Della Valle Index value is highest for export revenue. Both area under cultivation and quantity of fennel cultivated were medium instable over the time period 2006-07 to 2022-23. But export revenue earned from fennel turns out to be highly instable. The main reasons for this is that in the last few years fennel exports were decreased due to economic slowdown, low rainfall, heavy competition and low price(Rajah, 2023).

The market for fennel has been influenced by increased production and favorable climatic conditions, resulting in lower prices both domestically and internationally. This trend provides an interesting perspective on the supply-demand balance in agricultural commodities and impacts its prices. Recent data shows export prices for fennel have significantly decreased. Early April 2023 saw export prices at \$1,62 to \$1,63 per kg, which have now been reduced to around \$0,82 per kg. (CMB News, 2024).

6. Researches, conducted so far, to enhance production of fennel

New researches are taking place in different countries to discover more uses of fennel and better ways to expand production and its techniques. In Italy, researchers have identified a new chemotype of fennel from Montenegro, and studies have been conducted on the chemical composition of fennel essential oils (Bozovic, 2022). The study identified a new chemotype of fennel rich in TER, which was previously unreported. The study suggests that the chemical composition of fennel essential oil can vary depending on the geographical location and habitat.

In India, researchers have been experimenting with different sowing times and methods to increase fennel production. The farmers of Sabarkantha district in north Gujarat were cultivating local fennel varieties with conventional methods thereby receiving low yield per unit area. Krishi Vikas Kendra, Sabarkantha helped farmers by providing new varieties and

field demonstrations. This improved variety GF-12 gave average yield of 18.75 q/ha, net return of ₹89471/ha from Shri Arvindbhai Bhanjibhai Patel's field. It caused an increase of 13.63 percent over the local practice (Sable, 2024).

A three-year-long study by researchers of Swami Keshawanand Rajasthan Agricultural University, Bikaner, "Management of Saline Soils and Use of Saline Water in Agriculture", covering Bikaner, Nagaur, Churu and Barmer districts to examine the yield of different varieties of the crop through drip irrigation with brackish water. The results of the research show that drip irrigation and saline water can increase the area under fennel cultivation and will also have expansionary impact on production and productivity. The fennel variety, RF-290, was found to be viable for irrigation with saline water. The research exhibits promising results for fennel cultivation in Rajasthan, which can become the largest producer of the crop, in India (Shivran, et al, 2023).

As all the above cases show that there is an attempt to enhance production and quality of fennel. On the other hand, a lot needs to be done to ensure that export prices of fennel don't decrease significantly. For that steps need to be taken to remove any restrictions on trade. For this India need to offer incentives, such as subsidies or tax benefits, to encourage farmers and exporters to increase fennel production and exports.

7. Conclusion

Use of fennel and similar spices in cooking and in pharmacology have increased during the last decade. The demand for fennel is predicted to continue to increase due to increasing population, changing food consumption behaviour and increasing demand for value-added products such as oil and powder. It also plays an important role for India's export revenue as India stands as the largest producer of spices in the world. Area under cultivation, volume of production and export of fennel showed a positive significant trend over the period 2006-07 to 2022-23. However, area and productions showed moderate instability while export turned out to be highly instable.

Researches are already going on for improving production and quality of fennel seeds. One need to encourage farmers to adopt proper soil preparation, irrigation management, and crop rotation. Organic fennel farming must be encouraged to cater to the growing global demand for organic spices. Along with this, one also need to take appropriate steps to stabilize the export prices of fennel. Initiatives to open up trade relations with other countries and to remove trade barriers can help in opening up new market. Initiatives to improve domestic demand for

fennel requires more public awareness regarding the health benefits of global. A multi-level approach can definitely brighten up India's revenue prospect from fennel cultivation.

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