

PRODUCTION TRENDS AND EXPORT COMPETITIVENESS OF INDIAN SAFFLOWER (*CARTHAMUS TINCTORIUS* L.): A GLOBAL PERSPECTIVE

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ABSTRACT

Safflower (*Carthamus tinctorius* L.) is a drought-tolerant rabi oilseed of which India was once the world's largest producer. The present study analysed the trend of world and Indian safflower production and the export competitiveness of India in safflower seed. Data were drawn from FAOSTAT (2000–2024), the Ministry of Agriculture and Farmers Welfare (state-level, 2019-20 to 2023-24) and ITC Trade Map (HS 120760, 2014–2024). The compound growth rates, the coefficient of variation, the Cuddy–Della Valle instability index, the revealed comparative advantage (RCA) and revealed symmetric comparative advantage (RSCA) indices, the trade specialisation index (TSI) and the Herfindahl–Hirschman index (HHI) of destination concentration were calculated. In 2024, India produced 50,214 t, 7.25 per cent of world production (692,515 t), down from 39.91 per cent in 2000, and ranked fifth behind Kazakhstan, the Russian Federation, Mexico and the United States of America. The compound growth rates of area and production in India were –8.90 and –7.51 per cent per annum, respectively, during 2000–2024, while yield increased at 1.53 per cent per annum. From 2019-20 to 2023-24, Karnataka and Maharashtra accounted for 86.55 to 92.05 per cent of the national output each year. India's safflower exports decreased from USD 5.31 million in 2014 to USD 1.84 million in 2024, while its share in world exports declined from 13.93 to 3.95 per cent. The RCA index was above unity in all years but fell from 8.17 to 2.09, while the TSI was positive in all years. Exports went mainly to a few East and Southeast Asian markets, with the Philippines alone accounting for 31.44 per cent in 2024 (HHI 1,732). India has a revealed but fast vanishing comparative advantage in safflower seed; halting the decline in area, improving yields and expanding the market base are key to strengthening it.

KEYWORDS: Export competitiveness; Growth and instability; Herfindahl–Hirschman index; Revealed comparative advantage; Safflower

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an annual oilseed of the family Asteraceae, which is grown in over 60 countries for its seed oil, flowers, dye, fodder and medicinal properties [1]. It is tolerant of drought, heat, cold and salinity and considered to be the most drought-tolerant oilseed crop, capable of producing good seed yields in semi-arid regions [2]. In the Russian Federation, Kazakhstan and Tajikistan, breeding has led to the development of safflower varieties recommended for sustainable cultivation in arid regions [3]. Although India's agricultural exports have increased from USD 34.5 billion in 2019-20 to USD 51.1 billion in 2024-25 [4], vegetable oils continue to be the biggest import in the country's agriculture sector [5, 6]. India is the fourth largest producer of oilseeds in the world with 20.8 per cent of the world's oilseed area and 10 per cent of the world's oilseed output [7] but in 2017-18 the production of oil from edible oilseeds was approximately 39 per cent lower than the consumption [8]. Safflower, of which India has been a major producer, has contracted significantly. It accounted for 0.19–0.36 per cent of the total oilseed area in India during 2019-20 to 2024-25 and the compound growth rates for area, production and yield were –3.35 per cent, –0.87 per cent and +2.80 per cent, respectively, during 1966-67 to 2024-25 [9]. Safflower area has decreased by 94.50 per cent and production by 88.57 per cent during 1985-86 to 2019-20 despite a

compound annual growth rate of 7.39 per cent in its minimum support price [10] and safflower oil production has dropped by 74.93 per cent from 2002-03 to 2017-18 [8].

India's production has declined, but safflower production has increased in other parts of the world. Safflower is cultivated in rain-fed regions of the south of Kazakhstan and is gradually moving to new agro-climatic zones, and in 2010 Kazakhstan became the second largest producer after India [11]. In 2014, Kazakhstan had 30.7 per cent of the global safflower area while India had 13.9 per cent [1]. These changes bring up the question of the extent of the erosion of India's position in world production and trade and whether India continues to have a comparative advantage in the export of safflower. The oilseed trade in India has been studied as a whole for the major oilseeds [12-14] and research on safflower has focused on value chains and farm economics in India [15-18]. Therefore, an assessment of India's safflower production in the global context and its connection with export competitiveness of India is required.

The present study, therefore, aimed to (i) analyse the trend of world safflower production and India's status as a major producer; (ii) estimate the growth and instability of safflower area, production and yield in India and describe the state-wise distribution of production; (iii) assess the export performance and competitiveness of India's safflower seed using export share, RCA, RSCA, TSI and HHI; and (iv) suggest measures for improving safflower production and export competitiveness in India.

LITERATURE REVIEW

Safflower as a multipurpose oilseed

Menegaes and Nunes [1] reviewed the economic exploitation of safflower, which includes the use of floral stems for the floricultural industry, grazing, silage and seed cake for animal feed, oil for the food, pharmaceutical and biodiesel industries, and petal colourants for culinary, cosmetic and textile purposes. Safflower is a multipurpose crop which has been underutilised due to lack of information on management, locally adapted varieties and product development as described by Emongor and Oagile [2]. Temirbekova et al. [3] investigated safflower grown in contrasting regions of the Russian Federation, southern Kazakhstan and Tajikistan and concluded that the Krasa Stupinskaya variety from central Russia was comparable with the southern varieties of Kazakhstan and Tajikistan in terms of oil accumulation and fatty acid composition.

Production trends of safflower in India

Chauhan et al. [9] observed that the compound growth rate of safflower area and production in India was maximum in 1970-71 to 1979-80 (2.23 and 6.12 per cent) and turned highly negative in 2010-11 to 2019-20 (-14.32 and -11.54 per cent), respectively, whereas yield growth was positive. Somanathan et al. [10] reported that the area and production of safflower decreased at the rate of 7.11 and 6.01 per cent per annum, respectively, from 1985-86 to 2019-20, while yield increased at 1.17 per cent per annum, and minimum support price was negatively correlated with area (-0.99) and production (-0.87) of safflower; they attributed the decline to the change in cropping pattern in favour of chickpea or other oilseeds, poor price realization, and limited market demand. According to Kumari and Malik [19] the area and production of safflower in India decreased at 4.19 and 2.69 per cent per annum, respectively, and productivity increased at 1.57 per cent per annum during 1970-71 to 2020-21, and that Karnataka and Maharashtra accounted for 90 per cent of the production, with the area and production shifting from Maharashtra to Karnataka, and that area was more unstable than productivity, and that higher remuneration from competing crops like rabi sorghum and chickpea was responsible for the decline in Maharashtra.

Economics and value chain of safflower

Rathod et al. [17] used the Cost-A, Cost-B and Cost-C concepts to study 120 safflower growers of Osmanabad and Hingoli districts of Marathwada region of Maharashtra and reported that the grain yield was 12.37 quintals/ha, Cost-C was ₹28,541.51/ha, gross returns were ₹38,122.15/ha, net profit was ₹9,580.64/ha and output-input ratio was 1.34. Raskar [18] conducted a study on 90 safflower growers of Akola district during 2018-19 and found that the average yield was 17.64 quintals/ha and output-input ratio was 1.70, price uncertainty (87.78 per cent growers), transportation (71.11 per cent), inadequate storage (68.69 per cent) and high commission charges (65.56 per cent) were the major marketing constraints. Sowmya et al. [15] identified that the value chain of safflower in Vikarabad district of Telangana is complex with multiple stakeholders and multiple marketing channels and value addition is not fully exploited due to lack of knowledge about value added products. Sowmya and Sravanthi [16] reported a cost of cultivation of ₹44,544 per hectare, an average yield of 17.5 quintals per hectare and net returns of ₹50,915 per hectare from 120 farmers in the same district, and found that value addition was restricted to refined and cold-pressed oil although dyes, cosmetics and food colours offered further scope.

Competitiveness of Indian agricultural commodities and oilseeds

Singh et al. [20] used RCA, RSCA, revealed competitive advantage and the trade specification coefficient along with compound growth analysis of India's agricultural trade and concluded that India continued to be competitive in spices but the ratio of exports to imports had slightly declined. Dev et al. [21] analysed the agricultural exports of India during the period 2000-01 to 2017-18 using semi-log growth rates, Cuddy-Della Valle index and RCA, and concluded that the RCA of groundnut, cotton, rice and maize improved while that of oilseeds, ginger, tea and wheat deteriorated. Borisagar et al. [12] calculated RCA, RSCA, trade specification coefficient and revealed competitive advantage for sesame, soybean, sunflower, linseed, groundnut and other oilseeds for India during 2000-2020 and concluded that India was highly competitive in sesame, groundnut and soybean but not in linseed

and sunflower. Aruna Kumari and Paladugu [13] conducted constant market share analysis of the major oilseed exports of India in 2009-2021 and found that the export growth of safflower was negative along with sesame, soybean and sunflower. Verma et al. [14] applied Markov chain analysis to examine the direction of oilseed exports from India in 2011-2022. At the macro level, India's agricultural exports and imports increased by 11.71 and 13 per cent annually on an average during 2000-2022, respectively, with a positive trade balance throughout the period [5] and agricultural exports declined by approximately 5.3 per cent in 2023-24 due to trade restrictions and fluctuations in global demand [6]. None of these studies has examined India's position in world safflower production along with its revealed comparative advantage, trade specialisation and destination concentration in safflower seed exports, which is the gap filled here.

MATERIALS AND METHODS

Data sources and reference periods

The study is based on secondary data. Data on the area harvested (ha), production (t) and yield (kg/ha) of safflower seed (FAOSTAT item 1446) for the period 2000-2024 were downloaded from FAOSTAT [22]. The total "China" reported by FAOSTAT was not used, as this would double count the total "China, mainland", and world totals were calculated as the sum of all countries reporting. The annual trade values of safflower seed (HS 120760) and total merchandise exports for 2014-2024 in USD thousand were sourced from the International Trade Centre (ITC) Trade Map database [23] for India's exports by importing market, India's imports, exports of all exporting countries and total exports of all countries. The state-wise area, production and productivity for 2019-20 to 2023-24 were taken from the Ministry of Agriculture and Farmers Welfare, Government of India [24], and the 2022-23 values, published in lakh hectares and lakh tonnes, were converted to thousand units (1 lakh = 100 thousand). The state table for 2024-25 (rabi season only) was not used. A FAOSTAT year t represents the Indian agricultural year $(t-1)-t$, e.g. the FAOSTAT area for 2020 is 51.79 thousand ha, which corresponds to the area reported by the Ministry for 2019-20.

Production was analysed for 2000-2024, divided into Period I (2000-2012) and Period II (2013-2024). Trade was analysed for the last 11 years (2014-2024) ending with the latest production year. The levels, shares and ranks are reported for the individual years: 2000 and 2024 for world production; 2000, 2012 and 2024 for India; each year from 2019-20 to 2023-24 for the states; and each year from 2014 to 2024 for trade.

Analytical framework

Growth rate analysis. Based on Dev et al. [21] and Kumari and Malik [19] compound annual growth rates (CAGR) of area, production, yield and export value were calculated by fitting a semi-log growth model by ordinary least squares:

$$\ln Y_t = a + bt \quad (1) \quad \text{CAGR (\%)} = (e^b - 1) \times 100 \quad (2)$$

where Y_t is the variable in year t , t is the time trend, and a and b are the parameters. The t -test was used to test the significance of the growth rate on b . The same model has been employed by Pragya et al. [5] for agricultural trade of India, while the same exponential function has been employed by Borisagar et al. [12] and Singh et al. [20].

Variability and instability. The coefficient of variation (CV) was used to measure the variability, $CV (\%) = (\sigma / \mu) \times 100$, where σ is the standard deviation and μ the mean [12, 20]. Since the CV exaggerates the variability of a series with a trend, the instability around the trend was measured by the Cuddy-Della Valle index as used by Dev et al. [21] and Kumari and Malik [19]:

$$CDVI = CV \times \sqrt{(1 - \text{Adj. } R^2)} \quad (3)$$

where $\text{Adj. } R^2$ is the adjusted coefficient of determination of the semi-log trend (equation 1).

Trade specialisation index. Following Saxena et al. [25], trade specialisation was measured as the ratio of net exports to total trade for each country and year:

$$TSI = (X_{ij} - M_{ij}) / (X_{ij} + M_{ij}) \quad (4)$$

where X_{ij} and M_{ij} are country i 's exports and imports of safflower seed (j). The index can vary from -1 (pure importer) to +1 (pure exporter).

Revealed comparative advantage. The index was calculated as the percentage of safflower seed in a country's total merchandise exports divided by the percentage of safflower seed in world merchandise exports [26]. If it is greater than one, it is a comparative advantage.

$$RCA_{ij} = (X_{ij} / X_i) / (X_{wj} / X_w) \quad (5)$$

where X_{ij} is country i 's safflower seed exports, X_i its total merchandise exports, X_{wj} world safflower seed exports and X_w total world merchandise exports. The index was calculated in a similar manner for India and for each of the other major exporters, based on their respective safflower seed exports and total merchandise exports. A country's share of world safflower seed exports is $(X_{ij} / X_w) \times 100$.

Revealed symmetric comparative advantage. Since the RCA index only captures export flows and is asymmetric, taking any value between zero and infinity, it was transformed to its symmetric form as in Rossato et al. [27]:

$$RSCA = (RCA - 1) / (RCA + 1) \quad (6)$$

The transformed index is bounded between -1 and +1; positive values indicate comparative advantage and negative values indicate comparative disadvantage.

Destination concentration. The Herfindahl-Hirschman index was used to measure the concentration of India's safflower seed exports in the importing markets, as done by Jeevan and Loksha [28]:

$$HHI = \sum S_k^2 \times 10,000 \quad (7)$$

where S_k is the share of market k in the exports of Indian safflower seed in a particular year (as a proportion). The index tends to 10,000 if one market represents the total exports. Shares were calculated based on the total of the reported destination values.

RESULTS AND DISCUSSION

Safflower production in the world and in India

World safflower production increased from 652,440 t in 2000 to 692,515 t in 2024, and world average yield rose from 752 to 829 kg/ha (Table 1). Production was still concentrated, with the five largest producers producing 85.94 per cent of world production in 2000 and 82.01 per cent in 2024, but the composition of the top five producers changed markedly (Fig. 1). India, which was the largest producer in 2000 with 39.91 per cent of the world output, dropped to fifth position in 2024 with 7.25 per cent. In 2024, Kazakhstan (33.03 per cent) and the Russian Federation (23.05 per cent) took the first and second places, respectively, with a combined share of 56.08 per cent of the world's safflower production. The second and third largest producers, the United States of America and Mexico, also saw their shares decline, from 19.64 to 8.49 per cent and 14.78 to 10.20 per cent, respectively. Safflower is a rain-fed crop that is being introduced into new agro-climatic zones in Kazakhstan (Didorenko et al. [11]) and varieties have been developed for arid conditions in the Russian Federation, Kazakhstan and Tajikistan (Temirbekova et al. [3]). Akgun and Soylemez [29] also reported that Kazakhstan accounted for 34.72 per cent of the world's safflower seed production in 2020, while Kazakhstan, the Russian Federation, India, the United States of America and Mexico produced 79.81 per cent of the world's safflower seed. Therefore, the claim that India is the top producer of safflower in the world [9] is not true for the latest year as India was ranked 5th in 2024 according to the data from FAOSTAT.

Table 1. Leading safflower producers and India's position, 2000 and 2024

Country	Production 2000 (t)	Share (%)	Rank	Production 2024 (t)	Share (%)	Rank	Yield 2024 (kg/ha)
Kazakhstan	25,340	3.88	7	228,717	33.03	1	723
Russian Federation	1,770	0.27	12	159,610	23.05	2	669
Mexico	96,438	14.78	3	70,634	10.20	3	1,520
United States of America	128,160	19.64	2	58,780	8.49	4	1,345
India	260,400	39.91	1	50,214	7.25	5	768
China, mainland	39,000	5.98	4	34,106	4.92	6	1,468
Türkiye	18	<0.01	19	29,000	4.19	7	1,141
United Republic of Tanzania	6,240	0.96	11	14,361	2.07	8	554
Kyrgyzstan	10,880	1.67	8	10,668	1.54	9	1,088
Argentina	30,850	4.73	6	9,184	1.33	10	721
World	652,440	100.00	—	692,515	100.00	—	829

Source: Computed from FAOSTAT [22]. Note: Countries ranked by 2024 production; rank among all reporting countries. World = sum of reporting countries, excluding the "China" aggregate; world yield = world production / world area. The 2024 production values for mainland China and the Russian Federation are FAO-imputed and that for the United Republic of Tanzania is an FAO estimate.

The Indian yield in 2024 (768 kg/ha) was lower than the world average (829 kg/ha), but higher than the yields of Kazakhstan (723 kg/ha) and the Russian Federation (669 kg/ha), where large areas of low yields bring down the world average; the Kazakh figure is close to the average yield of 0.68 t/ha for 2019–2023 reported by Didorenko et al. [11]. However, India's yield was approximately half of that in Mexico (1,520 kg/ha) and mainland China (1,468 kg/ha) and much lower than that in the United States of America (1,345 kg/ha) and Türkiye (1,141 kg/ha).

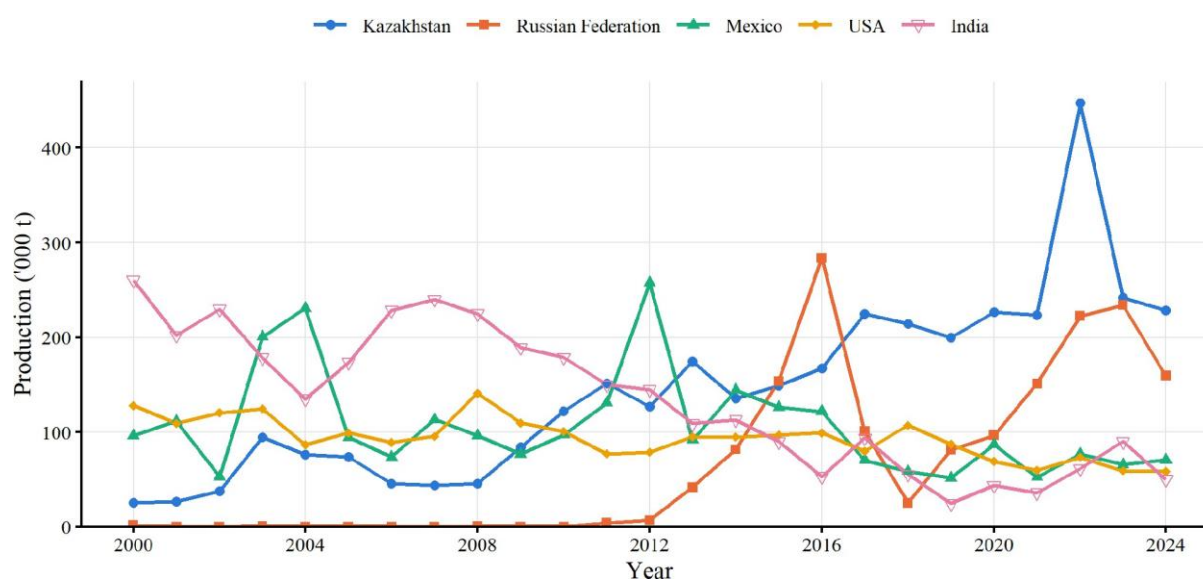


Figure 1. Safflower production of the five largest producers of 2024, 2000–2024

Source: FAOSTAT [22]. Note: Kazakhstan's 2022 production (447,457 t) is the official FAOSTAT value; values for the Russian Federation for 2023 and 2024 are FAO-imputed.

Production growth and instability of the main producers

World safflower production grew at 1.15 per cent per annum ($p < 0.01$) during 2000–2024 (Table 2). Its components were yield growth (0.54 per cent per annum) and growth in world area (0.61 per cent per annum), the latter of which was not significant. The new producers showed the highest growth: production in the Russian Federation increased by 42.75 per cent per annum, primarily due to an increase in area (37.39 per cent per annum), in Türkiye by 37.14 per cent per annum (mainly due to an increase in area by 33.59 per cent per annum), and in Kazakhstan by 9.97 per cent per annum (mainly due to an increase in area by 8.22 per cent per annum). In Türkiye, safflower has received per-kilogram product support since 2005 and deficiency payments since 2006, and production peaked in 2014–2015 and has since decreased [29]. Production, on the other hand, declined significantly in India (–7.51 per cent), Argentina (–6.15 per cent), the United States of America (–2.42 per cent) and Mexico (–2.34 per cent) and at the 10 per cent level in Kyrgyzstan (–1.31 per cent). Among the major producers, India had the highest rate of decrease in area (–8.90 per cent per annum). Instability in production was highest in Argentina (CDVI 70.48 per cent) and the Russian Federation (68.12 per cent) and lowest in mainland China (5.80 per cent).

Table 2. Compound growth rates and instability of safflower area, production and yield, 2000–2024

Country	Area CAGR (%)	Production CAGR (%)	Yield CAGR (%)	CDVI production (%)
World	0.61^{NS}	1.15^{***}	0.54^{***}	15.06
Kazakhstan	8.22 ^{***}	9.97 ^{***}	1.61 ^{***}	28.57
Russian Federation	37.39 ^{***}	42.75 ^{***}	3.90 ^{***}	68.12
Mexico	–4.74 ^{***}	–2.34 ^{**}	2.52 ^{***}	47.42
United States of America	–1.77 ^{***}	–2.42 ^{***}	–0.66 ^{**}	15.43
India	–8.90^{***}	–7.51^{***}	1.53^{**}	29.18
China, mainland	0.34 ^{NS}	0.34 ^{**}	0.00 ^{NS}	5.80
Türkiye	33.59 ^{***}	37.14 ^{***}	2.66 ^{***}	52.91
United Republic of Tanzania	1.84 ^{***}	3.39 ^{***}	1.52 ^{***}	8.63
Kyrgyzstan	–1.97 ^{***}	–1.31 [*]	0.68 ^{**}	27.25
Argentina	–5.52 ^{**}	–6.15 ^{**}	–0.67 ^{NS}	70.48

Source: Computed from FAOSTAT [22]. Note: CAGR estimated from the semi-log trend $\ln Y_t = a + bt$; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, NS not significant; $n = 25$. Yield computed as production / area.

Growth and instability in India's safflower area, production and yield

India's safflower area fell from 438,500 ha in 2000 to 178,000 ha in 2012 and 65,417 ha in 2024 (Fig. 2), a

decline of 85.1 per cent. Production fell by 80.7 per cent, from 260,400 t to 50,214 t, while yield increased by 29.3 per cent, from 594 to 768 kg/ha. Over 2000–2024, the compound growth rates were -8.90 per cent per annum for area and -7.51 per cent for production (both $p < 0.01$), while yield grew at 1.53 per cent per annum ($p < 0.05$) (Table 3).

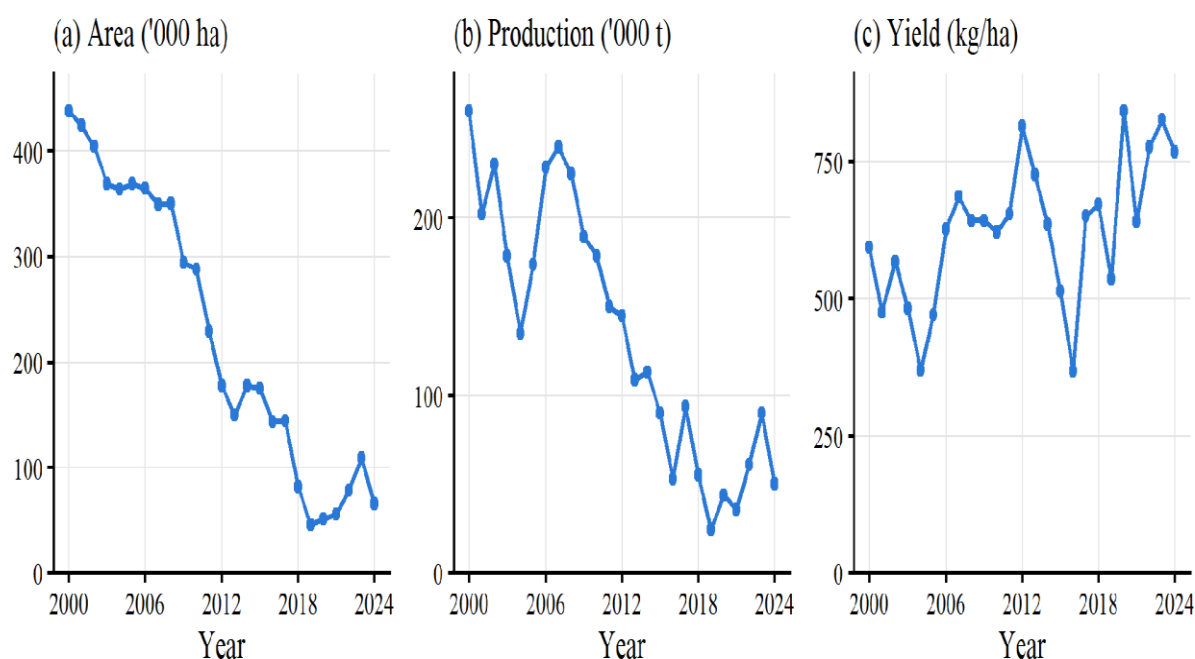


Figure 2. Safflower area, production and yield in India, 2000–2024

Source: FAOSTAT [22]. Note: Yield = production / area.

Table 3. Compound growth rates and instability of safflower area, production and yield in India

Variable – period	CAGR (%)	<i>t</i> -value	<i>R</i> ²	CV (%)	CDVI (%)
Area – Period I (2000–2012)	-5.69^{***}	-6.58	0.798	22.03	10.35
Area – Period II (2013–2024)	-9.16^{**}	-3.08	0.487	46.23	34.72
Variable – period	CAGR (%)	<i>t</i> -value	<i>R</i> ²	CV (%)	CDVI (%)
Area – Overall (2000–2024)	-8.90^{***}	-12.00	0.862	59.00	22.36
Production – Period I (2000–2012)	-2.44^{NS}	-1.73	0.213	20.27	18.78
Production – Period II (2013–2024)	-6.20^{NS}	-1.76	0.236	43.23	39.62
Production – Overall (2000–2024)	-7.51^{***}	-7.80	0.726	54.54	29.18
Yield – Period I (2000–2012)	3.45^{**}	2.78	0.413	19.56	15.65
Yield – Period II (2013–2024)	3.26^{NS}	1.77	0.239	21.01	19.21
Yield – Overall (2000–2024)	1.53^{**}	2.76	0.249	20.87	18.48

Source: Computed from FAOSTAT [22]. Note: $*** p < 0.01$, $** p < 0.05$, $* p < 0.10$, NS not significant. FAOSTAT year *t* corresponds to agricultural year $(t-1)-t$.

The reduction in area was significant for both sub-periods and was greater in Period II (−9.16 per cent per annum) than in Period I (−5.69 per cent). Yield increased significantly in Period I (3.45 per cent per annum) and increased by a similar amount, although not statistically significant, in Period II (3.26 per cent). Production showed a negative trend in both sub-periods, although it was only significant for the entire period. The decline in production was due to the decrease in area and not yield, since the decrease in area was greater than the increase in yield in both periods. Instability has become much more pronounced in Period II: the CDVI for area has jumped from 10.35 to 34.72 per cent, and for production from 18.78 to 39.62 per cent, suggesting that the contraction has been more rapid and more erratic in the last decade.

The results are in line with the strongly negative area and production growth reported by Chauhan et al. [9] for 2010-11 to 2019-20 and negative area and production growth and positive yield growth reported by Somanathan et al. [10] for 1985-86 to 2019-20 and by Kumari and Malik [19] for 1970-71 to 2020-21, who also found the area to be more unstable than productivity, as observed here for 2000–2024 (CDVI 22.36 per cent for area against 18.48 per cent for yield). The literature points to the reasons for the loss of area. While the increase in minimum support prices did not stop the decline, Somanathan et al. [10] attributed this to the changing cropping pattern, lower price realisation and limited market demand, while growers in Akola reported price uncertainty as their most common constraint in marketing [18]. Farm level studies in Maharashtra have shown positive but limited returns with output-input ratio of 1.34 in Marathwada region [17] and 1.70 in Akola district [18]. India's yield, although not far below the world average, is about half of that in Mexico and mainland China. The productivity of Telangana is higher than the national average in all the years from 2019-20 to 2023-24, which suggests that the yield gap can be reduced.

Safflower production in India by states

In India, the production of safflower is limited to a few states (Table 4). The combined production of Karnataka and Maharashtra ranged from 86.55 to 92.05 per cent of the national production in each year from 2019-20 to 2023-24 and the combined production of Karnataka, Maharashtra and Telangana ranged from 95.46 to 97.83 per cent of the national production in each year during the period. Karnataka was the leading state from 2019-20 to 2022-23, with 53.75–62.22 per cent of national production, but its production fell from 56.00 thousand t in 2022-23 to 12.67 thousand t in 2023-24 and its share from 62.22 to 25.23 per cent, while Maharashtra's share rose from 25.56 to 63.47 per cent. Chauhan et al. [9] also reported that Maharashtra has the highest share of national acreage (65.6 per cent) and production (60.5 per cent) in 2024-25. Kumari and Malik [19] also observed that the two states accounted for 90 per cent of production till 2020-21. This sort of concentration and the sudden turnaround of shares makes the national supply vulnerable to the conditions of two states.

Table 4. State-wise safflower production ('000 t) and productivity in India, 2019-20 to 2023-24

State	2019-20	2020-21	2021-22	2022-23	2023-24	Productivity 2023-24 (kg/ha)
Maharashtra	14.93	12.18	19.05	23.00	31.87	771
Karnataka	25.27	19.29	33.98	56.00	12.67	745
Telangana	2.21	2.79	6.91	8.00	4.07	1,017
Andhra Pradesh	0.49	0.49	0.66	3.00	1.06	478
Odisha	0.18	0.10	0.39	0.00	0.40	630
India	43.67	35.89	61.27	90.00	50.21	768

Source: Ministry of Agriculture and Farmers Welfare [24]. Note: States ordered by 2023-24 production. Other states, each with less than 0.5 thousand t in every reported year, are not shown. 2022-23 values converted from lakh units.

State productivity was highly variable. Telangana had the highest productivity of the three major producing states in all the years from 2019-20 to 2023-24, with 1,017 kg/ha in 2023-24, compared to 771 kg/ha in Maharashtra and 745 kg/ha in Karnataka, and 768 kg/ha at the national level, indicating that productivity above the national average is already being achieved in India.

Safflower export performance and competitiveness in India

In the case of safflower seed, exports from India decreased from USD 5,306 thousand in 2014 to USD 1,835 thousand in 2024 at a compound growth rate of -10.76 per cent per annum ($p < 0.01$), while the world exports did not show any significant trend (3.32 per cent per annum) (Table 5). As a result, India's share of world safflower seed exports has decreased from 13.93 per cent in 2014 to 3.95 per cent in 2024, with a low of 2.16 per cent in 2023. The reduction is in line with the negative growth in the export of safflower from India as reported by Aruna Kumari and Paladugu [13] during 2009-10 to 2021-22.

Table 5. India's safflower seed trade, competitiveness and destination concentration indices, 2014–2024

Year	India exports (USD '000)	India imports (USD '000)	World exports (USD '000)	India's share (%)	RCA	RSCA	TSI	HHI
2014	5,306	26	38,078	13.93	8.17	0.782	0.990	1,194
2015	3,919	267	56,012	7.00	4.31	0.623	0.872	885
2016	4,924	946	56,780	8.67	5.23	0.679	0.678	1,316
2017	3,708	937	48,936	7.58	4.46	0.634	0.597	2,508
2018	3,143	1,225	37,761	8.32	4.90	0.661	0.439	3,038
2019	2,535	106	46,983	5.40	3.09	0.511	0.920	2,413
2020	1,495	169	65,583	2.28	1.43	0.177	0.797	1,655
2021	3,260	0	79,403	4.11	2.28	0.390	1.000	2,356
2022	1,773	0	48,435	3.66	1.92	0.315	1.000	2,514
2023	1,786	0	82,658	2.16	1.15	0.068	1.000	1,801
2024	1,835	1	46,405	3.95	2.09	0.352	0.999	1,732
CAGR (%)	-10.76***	—	3.32^{NS}	—	—	—	—	—

Source: Computed from ITC Trade Map [23]. Note: RCA, RSCA, TSI and HHI as defined in equations 4–7. CAGR from the semi-log trend; *** $p < 0.01$, NS not significant.

The RCA index was greater than one in all the years (Table 5; Fig. 3), which indicated that India maintained its RCA in safflower seed. Its magnitude, however, fell from 8.17 in 2014 to 2.09 in 2024, with a low of 1.15 in 2023. The RSCA index also fell from 0.782 to 0.352 and was approaching towards the world average in 2023 (0.068), which shows that India's specialisation in safflower seed was getting closer to the world average. This erosion is in line with the decline in India's comparative advantage in oilseeds reported by Dev et al. [21] for 2000-01 to 2017-18. The decline in India's share of world exports, which was more than two-thirds, was not due to a significant decline in world exports, but rather to India's own loss of exportable supply and market share, as indicated by the decline in area and output. The TSI was positive throughout, from 0.439 in 2018 (when imports were USD 1,225 thousand) to 1.000 in 2021-2023 (when no imports were recorded). India is thus a net exporter of safflower seed and its competitiveness issue is not import dependence but the falling value of its exports.

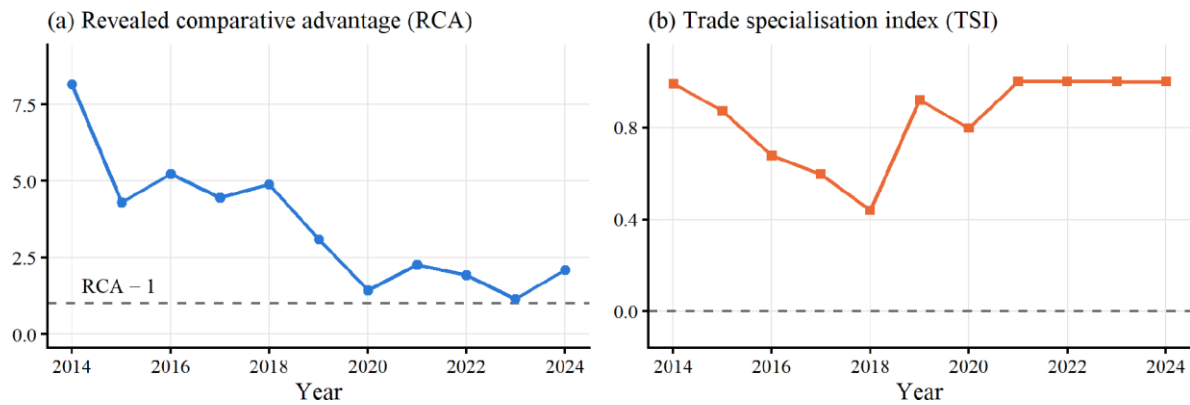


Figure 3. India's revealed comparative advantage (RCA) and trade specialisation index (TSI) in safflower seed, 2014–2024

Source: Computed from ITC Trade Map [23]. Note: The dashed lines mark $RCA = 1$ and $TSI = 0$.

India's rank as a major exporter of safflower

In 2024, the world export of safflower seed was led by Kazakhstan with 53.20 per cent, followed by the Netherlands (12.00 per cent), Spain (10.43 per cent) and Türkiye (5.66 per cent) (Table 6). India was in fifth position with 3.95 per cent. The RCA of Kazakhstan in 2024 (151.06) was extremely high due to the fact that it exported 53.20 per cent of the world's safflower seeds, but only 0.35 per cent of the world's merchandise exports; its exports of safflower seeds increased by 20.83 per cent annually in 2014–2024, and according to Didorenko et al. [11], 3.55 thousand tonnes of them were exported to China in 2023. In 2024, India's RCA (2.09) was lower than Kazakhstan (151.06), Egypt (9.61), Spain (5.99), Türkiye (5.01) and the Netherlands (3.98) among the top ten exporters, and the RCA of the United States of America, China, Poland and Canada were below unity. India's RCA (8.17) was the second highest among these countries in 2014 after Kazakhstan (35.78). Among the top ten exporters for which a growth rate could be calculated, India was the only country whose exports decreased between 2014 and 2024 (at an annual rate of -10.76 per cent). As a large importer and exporter, Türkiye's RCA was accompanied by a negative TSI (-0.629 in 2024), while India's TSI (0.999) indicates an almost exclusively export-oriented trade.

Table 6. Leading safflower seed exporters: market share and competitiveness indices, 2024

Exporter	Exports 2024 (USD '000)	Share 2024 (%)	RCA 2014	RCA 2024	RSCA 2024	TSI 2024	Export CAGR 2014–24 (%)
Kazakhstan	24,688	53.20	35.78	151.06	0.987	0.967	20.83***
Netherlands	5,568	12.00	3.17	3.98	0.598	0.598	4.21 ^{NS}
Spain	4,839	10.43	0.56	5.99	0.714	0.338	32.28***
Türkiye	2,626	5.66	4.77	5.01	0.667	-0.629	16.14 ^{NS}
India	1,835	3.95	8.17	2.09	0.352	0.999	-10.76***
United States of America	1,528	3.29	0.41	0.37	-0.460	-0.323	6.72*
Egypt	863	1.86	1.55	9.61	0.812	1.000	^a
China	743	1.60	<0.01	0.10	-0.812	-0.893	27.82*
Poland	708	1.53	0.25	0.93	-0.036	-0.548	20.69***
Canada	681	1.47	0.37	0.60	-0.252	-0.306	15.91***

Source: Computed from ITC Trade Map [23]. Note: Exporters ranked by 2024 exports. The Russian Federation (last reported in 2021) and the Islamic Republic of Iran (last reported in 2023), whose last reported exports exceeded those of the tenth-ranked exporter, are not included because Trade Map reports no 2024 exports for them. ^a Not computed because the series contains years with zero exports. *** $p < 0.01$, * $p < 0.10$, NS not significant.

Safflower export destinations of India

Safflower exports from India were limited to a few markets. The HHI rose from 1,194 in 2014 to a peak of 3,038 in 2018 and stood at 1,732 in 2024 (Table 5). In 2024, the Philippines (31.44 per cent), Chinese Taipei (18.15 per cent), the Republic of Korea (14.71 per cent) and Japan (10.84 per cent) were the leading destinations, followed by the United Arab Emirates (5.12 per cent) (Table 7). Thus, India's safflower exports

are concentrated in a few buyers in the East and Southeast Asian markets, with the Philippines accounting for nearly one-third of the exports. The dependence on a few markets exposes India's exports to changes in demand or competition in those markets.

Table 7. Leading destinations of India's safflower seed exports, 2024

Destination	Exports 2014 (USD '000)	Exports 2024 (USD '000)	Share 2024 (%)
Philippines	834	577	31.44
Chinese Taipei	621	333	18.15
Korea, Republic of	171	270	14.71
Japan	217	199	10.84
United Arab Emirates	141	94	5.12
Kuwait	64	79	4.31
Thailand	23	68	3.71
Bahrain	147	57	3.11
Viet Nam	0	43	2.34
South Africa	22	32	1.74

Source: Computed from ITC Trade Map [23]. Note: Destinations ranked by 2024 exports. Share = destination's 2024 exports / India's total 2024 exports to all destinations × 100.

CONCLUSION

This study was undertaken to understand the status of India in the world safflower production and trade with the help of FAOSTAT, Trade Map and state level data. India, which was the largest producer of safflower in 2000, was the fifth largest producer in 2024 with 7.25 per cent of the world's production, which moved towards Kazakhstan and the Russian Federation. India's safflower area decreased at a compound growth rate of –8.90 per cent per annum during 2000-2024, whereas the production decreased at –7.51 per cent per annum and yield increased at 1.53 per cent per annum during the same period. Production is mainly in Karnataka and Maharashtra and India's yield is far less than that of intensive producers. India maintained its RCA in trade throughout 2014-2024, but its RCA decreased from 8.17 to 2.09 and its share of world exports decreased from 13.93 to 3.95 per cent. India is a net exporter and its exports are reliant on a handful of Asian markets.

Policy implications

1. The reduction in area has outweighed the increase in yield, and the recovery of safflower should focus on maintaining and increasing the area of the crop, with the aim of increasing the returns that farmers receive from it, as farm-level studies indicate that returns are modest [17, 18]. Support prices alone have not been able to stop the decrease in the area of safflower [10] and should be combined with guaranteed marketing because the most common constraint reported by producers is price uncertainty [18] and a purchase guarantee for producers has been suggested for safflower in Türkiye [29].
2. India's yield of 768 kg/ha in 2024 was about half of that in Mexico (1,520 kg/ha) and mainland China (1,468 kg/ha). Increased output could be achieved at the same area through the use of quality seed and better varieties, adoption of recommended practices and extension of the practices of higher productivity states like Telangana.
3. The National Mission on Edible Oils – Oilseeds, which is focused on achieving self-reliance in edible oils by 2030-31 through area expansion, quality seed and better technology [4] provides a ready framework for integrating safflower in these efforts.
4. Karnataka and Maharashtra together contribute between 86.55 and 92.05 per cent of the national output in each year, and hence the national supply is vulnerable to the situation in these two states. This concentration could be reduced and supply stabilised by promoting safflower in other appropriate rain-fed regions.
5. Value addition in safflower is largely untapped and marketing is limited to refined and cold-pressed oil; new value-added products like dyes, cosmetics and food colours would increase returns along the value chain [15, 16] and provide greater incentive for growing the crop.

6. India's safflower exports are limited to a few markets in East and Southeast Asia. Exporters and trade promotion agencies should consolidate these markets and broaden the market base, to make exports less vulnerable to fluctuations in the demand of a few buyers. Future studies might include export volumes and unit values and primary surveys of safflower growers and traders to determine farm level and marketing constraints.

Limitations of the Study

Levels, shares and ranks are for individual years and are therefore subject to year-specific weather or market conditions; the growth and instability estimates over the entire period complement these. Trade values are in current US dollars and thus reflect both price and quantity changes. The Russian Federation reported USD 32,753 thousand exports of safflower seed in 2021, but no data for 2022-2024, which tends to inflate the export shares and RCA values of other countries, including India, from 2022 onwards, as the world totals are the sum of reporting countries. Didorenko et al. [11] also report that Kazakhstan imported safflower seed from the Russian Federation for re-export to third countries, which means that some of the safflower seed exported from Kazakhstan may be from the Russian Federation. Some of the production values for 2024 are imputed or estimated, and the state level production data for 2022-23 are released at a coarser level (lakh units) compared to other years.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

The data analysed in this study are publicly available from FAOSTAT, ITC Trade Map and the Ministry of Agriculture and Farmers Welfare, Government of India, as cited in the references. The compiled dataset is available from the corresponding author upon reasonable request.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

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