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Export Performance of Indian Pepper - Magnitude, Direction and Competitiveness

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Abstract

India is the world producer, consumer and exporter of spices. India produces about 75 of the 109 spices which are listed by the International Organization for Standardization (ISO). Indian spices are globally renowned for their flavours and aromas. In 2022-23, India's spice exports were valued at US$ 3.73 billion, with pepper contributing US$ 87 million from the exports of 19,031 MT. This study examined status and performance of pepper exports from India by employing Compound Annual Growth Rate, Cuddy-Della Valle Index, Export Unit Value Index, Revealed Comparative Advantage (RCA), Revealed Systematic Comparative Advantage (RSCA), Hirschman-Herfindahl Index and Markov chain analysis using the quantity of exports and their earnings during the period from 2012-13 to 2022-23. India ranked fourth in global pepper exports with an average global export share of 5.32 per cent and its exports were decreasing at the rate of 6.70 per cent. India's Export Unit Value Index (3.11) was the lowest among the major exporting countries, indicating that India's pepper is fetching lower price in the international market. India, with RCA values ranging from 2.52 to 2.91 over the last five years, showed a moderate comparative advantage in the exports of pepper. However, its RSCA values decreased from 0.49 in 2018 to 0.43 in 2022, indicating a slight decline in its comparative advantage during the study period. The Hirschman-Herfindahl Index (HHI) for Indian pepper exports was 2422.75, which revealed a moderate degree of market concentration, indicating that Indian pepper exports were heavily reliant on a very few countries, which could affect India's market stability and competitiveness. USA and Canada were found to be the most stable markets among the major importers of Indian pepper as reflected by the higher probability of retention at 72.6 per cent and 63.2 per cent, respectively. Therefore, India's export strategies should concentrate on extension of these markets and promote exports through supportive EXIM policies.

Keywords : Pepper exports, Competitiveness, Comparative advantage, Market concentration

Status and Performance of Pepper Exports of India

Indian spices are renowned for their delightful flavours and enticing aromas. India is the largest producer, consumer and exporter of spices in the world, hence known as 'Spice Bowl of the World'. Renowned for its rich culinary heritage, India produces and exports a diverse range of spices. According to the Spices Board of India, India exported over 1.4 million MT of spices during the fiscal year 2022-2023. Major spices exported from India include chilli, turmeric, cumin, cardamom and pepper. India's strategic geographical location, combined with favourable climatic conditions, enables the cultivation of a wide variety of spices, ensuring a steady and reliable supply to international markets. The major export destinations

for Indian spices include China, the USA, Bangladesh and various European Union countries.

India is a significant global player in the export of pepper and as one of the largest producers and exporter of pepper, India consistently exported substantial quantities of pepper annually. In the fiscal year 2022 -23, the country exported 19,031 MT. of pepper, making it one of the leading exporters in the world. The primary export destinations for Indian pepper include the USA, UK, Germany and other European Union and Asian countries. India's expertise in pepper cultivation, coupled with its diverse climatic conditions suitable for pepper cultivation, has enabled it to maintain a prominent position in the global spice trade.

Despite a phenomenal increase in production of pepper (8.8% CAGR) over the years, India's export is decreasing at CAGR of 6.8 per cent and also India's share in global pepper exports has decreased from 9.7 per cent during 2013 to 4.7 per cent in 2022. With this background information, the research was carried out with the objective to analyse the status, performance and export competitiveness of Indian pepper exports.

METHODOLOGY

The analysis was based on the data of quantity and value of exports of pepper for the last ten years (2013 to 2022), collected from United Nations Comtrade Database. Time series data as per 6-digit Harmonized Commodity Description and Coding System, also known as the Harmonized System Codes (HSC) was taken to study the export trends and competitiveness.

Vietnam, Brazil, Indonesia, India and Germany being the major pepper exporting countries, these countries were considered to evaluate the growth and instability in exports by computation of Compound Annual Growth Rate (CAGR) and Cuddy-Della Valle Index (CDVI).

To analyse the export competitiveness, Export Unit Value Index (EUVI), Revealed Comparative Advantage (RCA), Revealed Systematic Comparative Advantage (RSCA) were used. To analyse the market concentration, Hirschman-Herfindahl Index (HHI) was used and to study the export destination dynamics, Markov Chain Approach was used. USA, UK, Germany, Canada, Sweden, Spain, Netherlands, Japan, Russia and Australia were the major pepper importing countries from India and hence considered for the analysis. The detailed description of analyses carried out in the study is presented below:

Compound Annual Growth Rate of Exports

To estimate the growth rates in export quantities of pepper, the compound growth rate technique was employed using the following exponential form of model.

$y = ab^t e^u$ …….....(1)

Where,

'y' is Dependent variable (Quantity of pepper exports)

'a' is Intercept term(constant)

'b' is Regression coefficient

'a' and 'b' are the parameters to be estimated

't' is Time period

'u' is Error term

The equation (1) was transformed into log linear form as below and was estimated by using the Ordinary Least Squares (OLS) technique,

$\ln y = \ln a + t \ln b + u$…. ……(2)

Compound annual growth rate (g) in percentage was computed as follows,

CAGR (g) = [*antilog of lnb* – 1]* 100.....(3)

Instability Analysis

Cuddy-Della Valle Index (CDVI) was used to measure the instability (Mondal, 2022) in the exports of pepper. This index is preferred over the normal coefficient of variation (CV) as it attempts to de-trend the CV by using co-efficient of determination and showing the exact direction of instability (Cuddy and Valle, 1978). CDVI is obtained for the CV.

CV = (Standard Deviation / Mean)* 100 .....(4)

CDVI is estimated as follows,

$$CDVI = CV * \sqrt{1 - R^2} \quad \text{.....(5)}$$

Where,

'CV' is the coefficient of variation in percentage

'R^2' is the coefficient of determination from the regression adjusted for its degrees of freedom

If the index value is below15 per cent then it is categorized as low instability, if the value lies between 15 and 20 per cent then it is categorized as medium instability and more than 20 per cent is categorized as high instability.

Export Competitiveness and Performance of Pepper

Export Unit Value Index (EUVI)

To analyse the export competitiveness, Export unit value index was used, it refers to the average value realized per unit quantity of export of pepper, calculated by dividing the total value of exports by the total quantity exported. Export unit values provide insights into pricing trends, competitive positioning and market demand. Higher unit values indicate high-quality or specialized products, these values help in determining the competitiveness of a country's products in international markets by comparing the export prices with those of other countries. Mathematically, Export unit value index is expressed by the following equation:

$$\text{EUVI} = \frac{\text{Value realized from the exports of a commodity in the same year}}{\text{Quantity of exports of a commodity from a country in a year}}$$

Revealed Comparative Advantage (RCA) Analysis

Revealed Comparative Advantage (RCA) is an index used to determine the relative advantage or disadvantage of a certain country in trade of a particular commodity, as evidenced by trade flows. A country is said to have comparative advantage over another country, if it can produce a particular commodity more efficiently than the other country. RCA index was used to compute the 'relative advantage' and 'relative disadvantage' in the pepper exports of major exporting countries. Its formula defined as a country's share of world exports of pepper divided by its share of total world exports.

$$RCAij = \frac{\frac{Xij}{Xik}}{\frac{Xnj}{Xnk}}$$

The index for country 'i' and commodity 'j' is calculated as follows,

Where,

X_{ij} = Exports of country 'i' of commodity 'j' (Pepper)

X_{ik} = Total exports of country 'i'

X_{nj} = Exports of the world of commodity 'j' (Pepper)

X_{nk} = Total exports of the world 'n'

RCA index value ranges from 0 to ∞. RCA greater than 1 indicates that the county is having 'comparative advantage' in trade of a commodity while RCA less than 1 indicates that the country is having 'comparative disadvantage' in trade of the same commodity.

Revealed Symmetric Comparative Advantage (RSCA) Analysis

Revealed Comparative Advantage (RCA) index was used to measure comparative advantage, developed by Balassa (1965), was widely used in competitiveness analysis (Mizik, 2021 and Saki *et al.,* 2019). However, RCA suffered from the problem of asymmetry, since it is not comparable on both sides of unity. Hence, RCA was made symmetric, following the methodology suggested by Dalum *et al.* (1998) and the resultant index is called as 'Revealed Symmetric Comparative Advantage' (RSCA).

Mathematically, it can be expressed by the following equation

$$RSCA = \frac{(RCA - 1)}{(RCA + 1)}$$

RSCA index value ranges between -1 and +1 and is free from the problem of skewness. A commodity is said to have comparative advantage in its exports if the corresponding RSCA value is positive and vice versa.

Market Concentration of Indian Pepper Exports

In any cross-border trade, Market diversification is very important since more reliance of very few markets affects the economy, whenever there is reduction in demand by those countries. Instead, having a good number of stable markets is proven beneficial since demand fluctuations in a few markets will be offset by other more stable markets. In broad sense, market diversification leads to less vulnerability to global economic shocks, demand slowdowns and new competition.

The Hirschman-Herfindahl Index (HHI) was used to measure the concentration, diversification or market competitiveness of Indian pepper market. Herfindahl-Hirschman Index (HHI) is computed by summating the squares of the export shares of all trading partners of a particular commodity, *i.e.,*

$$HHI = \sum_{i=1}^{n} S_i^2 * 10000$$

Where,

HHI = Hirschman-Herfindahl Index

S_i^2 = Square of the exportshare of the i^{th}country among the trading partners.

HHI values ranges from 0 to 10000. A market with an HHI of less than 1,500 is considered a less concentrated market, an HHI of 1,500 to 2,500 is considered a moderately concentrated market and an HHI above 2,500 indicates highly concentrated market.

Markov Chain Analysis

The export destination dynamics of exports of Indian pepper was analysed by using the first order Markov chain approach. Markov chain analysis is done by the estimation of the transitional probability matrix P. The elements (P_{ij}) of the matrix P indicate the probability that export will switch from country 'i' to country 'j' over the time. The diagonal elements of the matrix indicate the probability that the export share of a country with its trading partner is retained. Hence, the examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports. In this context, structural changes in the exports will be treated as a random process with selected ten importing regional countries. The average exports to a particular regional country are considered to be a random variable which depends only on past exports to that regional country, which can be denoted algebraically as

$$Ejt = \sum_{i=1}^{r} E\,it - 1 * Pij + ejt$$

Where,

E_{jt} = Exports from India to j^{th} country during the year 't'

E_{it-1}= Exports to i^{th} country during the period t-1

P_{ij} = Probability that the exports will shift from i^{th} country to j^{th} country

e_{jt} = The error term which is statistically independent of 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.

- $\leq Pij \leq 1$
- $\sum_{i=1}^{n} P\,ij = 1\ for\ all\ i$

Results and Discussion

India is the largest producer and exporter of spices, contributing over 70 per cent to the world's spice market. India is the second largest producer of pepper after Vietnam, it is also the fourth largest exporter of pepper with an export share of 5. 32 per cent, with substantial export earnings.

Major Exporters of Pepper in Global Market

Vietnam holds predominant position in global pepper trade. Among the exports of raw pepper in last decade

(2013-2022), Vietnam had an average annual export of more than 1.5 lakh tonnes with an average export share of 41.34 per cent in the same period. Brazil and Indonesia held second and third position with average export share of 16.58 per cent and 12.04 per cent respectively. These three countries altogether accounted for 70 per cent export share in this period. In spite of being second largest producer of pepper, India stood at fourth position in the exports of raw pepper with meagre share of 3.72 per cent, followed by Sri Lanka (3.11%).

The computed CAGR of raw pepper exports indicated that the Brazil's exports were increasing significantly at the rate of 15.49 per cent annually, whereas the Vietnam's exports were increasing at just 3.59 per cent annually. On the other hand, exports of Indonesia, India and Sri Lanka were decreasing at the rate of 2.32 per cent, 10.50 per cent and 0.69 per cent, respectively. The major exporters of raw pepper in global market are presented in Table 1.

Table 1

Major exporters of raw pepper in global market (HSC – 090411)

Exporters	Average exports (tonnes)	Export share (%)	CAGR (%)	CDVI
Vietnam	153844	41.34	3.59	30.17
Brazil	61681	16.58	15.49 **	17.11
Indonesia	44819	12.04	-2.32	22.02
India	13856	3.72	-10.50	37.94
Sri Lanka	11565	3.11	-0.69	38.22

Note: **, * indicates significance at one and five per cent, respectively

Further, the major exporters of processed pepper in global market are presented in Table 2. Even in the exports of processed pepper, Vietnam stood first with an average export share of 32.70 per cent and its exports was significantly increasing with CAGR of 9.66 per cent. India occupied second position with a share of 13.20 per cent and its exports were slightly decreasing at the rate of 0.59 per cent. Germany, USA and the Netherlands occupied next three positions in the export of processed pepper with share of of 8.19 per cent, 7.45 per cent and 5.42 per cent, respectively. Among these countries, exports of USA were decreasing significantly, which was indicated by negative CAGR of 7.63 per cent.

Table 2

Major exporters of processed pepper in global market (HSC – 090412)

Exporters	Average exports (tonnes)	Export share (%)	CAGR (%)	CDVI
Vietnam	24815	32.70	9.66 *	41.29
India	10015	13.20	-0.59	5.41
Germany	6216	8.19	-1.43	14.22
USA	5651	7.45	-7.63 *	27.64
Netherlands	4116	5.42	-0.47	19.37

Note: **, * indicates significance at one and five per cent, respectively

When the overall exports of pepper were considered, Vietnam still stood in first place with average export share of 39.79 per cent, whose exports were increasing at rate CAGR of 4.64 per cent. Brazil, Indonesia, India and Germany occupied the next positions with export shares of 13.77 per cent, 10.28 per cent, 5.32 per cent and 3.15 per cent, respectively. Brazil's exports were significantly increasing at CAGR of 15.48 per cent, whereas India's exports were decreasing at 6.78 per cent which was indicated by negative CAGR.

Results of the Cuddy-Della Valle Index (CDVI) showed that, pepper exports of Vietnam, Indonesia and India had higher instability with index values of 29.38 per cent, 21.49 per cent and 22.53 per cent, respectively. Whereas, Brazil exhibited moderate instability (17.08%) and Germany exhibited low stability (8. 78%) in the pepper exports. The major exporters of pepper in global market are presented in Table 3.

Trends in Exports Share of Major Pepper Exporting Countries in Global Trade

Fig. 1 shows the trends in exports share of major pepper exporting countries in global market during

TABLE 3

Major exporters of pepper (Raw and processed) in global market

Exporters	Average exports (tonnes)	Export share (%)	CAGR (%)	CDVI
Vietnam	178659	39.79	4.64	29.38
Brazil	61834	13.77	15.48 **	17.08
Indonesia	46159	10.28	-2.22	21.49
India	23871	5.32	-6.78	22.53
Germany	14151	3.15	1.01	8.78

Note: **, * indicates significance at oneand five per cent, respectively

2013-2022. Vietnam being the largest exporter of pepper, had maintained export share of more than 30 per cent in this period, except in 2018, its export share was dropped to 25.25 per cent. It is notable that Vietnam's share had reached 48.21 per cent in the year 2019, which was highest ever in the study period. The export share of Brazil had increased over the years from 7.73 per cent in 2013 to 20.41 per cent in 2022. The export share of Indonesia fluctuated between 12.11 per cent in 2013 and 6.99 per cent in 2022. India, though was a dominant player in the global pepper market and known as 'Spice Bowl of World', held less than 5 per cent share since 2017 and 4.72 per cent in 2022, while it was 9.75 per cent in 2013. Germany being the fifth major exporter of pepper, retained export share of 2 to 4 per cent in the study period. It is evident from Fig. 1, that Vietnam's export share in the global pepper market was exceptionally high when compared to other major exporters.

Export Unit Value Index (EUVI) of Major Exporters of Pepper in Global Trade

The Table 4 presents the Export Unit Value Index (EUVI) for raw and processed pepper of major exporting countries: Vietnam, Brazil, Indonesia, India and Germany. The EUVI measures the change in export prices over time, reflecting the value per unit of goods exported. For raw pepper (HSC-090411), Indonesia had the highest EUVI of 4.97, reflecting a higher price for its raw pepper exports compared to other countries, followed by Vietnam and India (4.73 and 4.72, respectively), indicating similar export values per unit. Brazil, with EUVI of 3.59, had the lowest index for raw pepper, implying that it exported raw pepper at lower prices compared to the other major exporters.

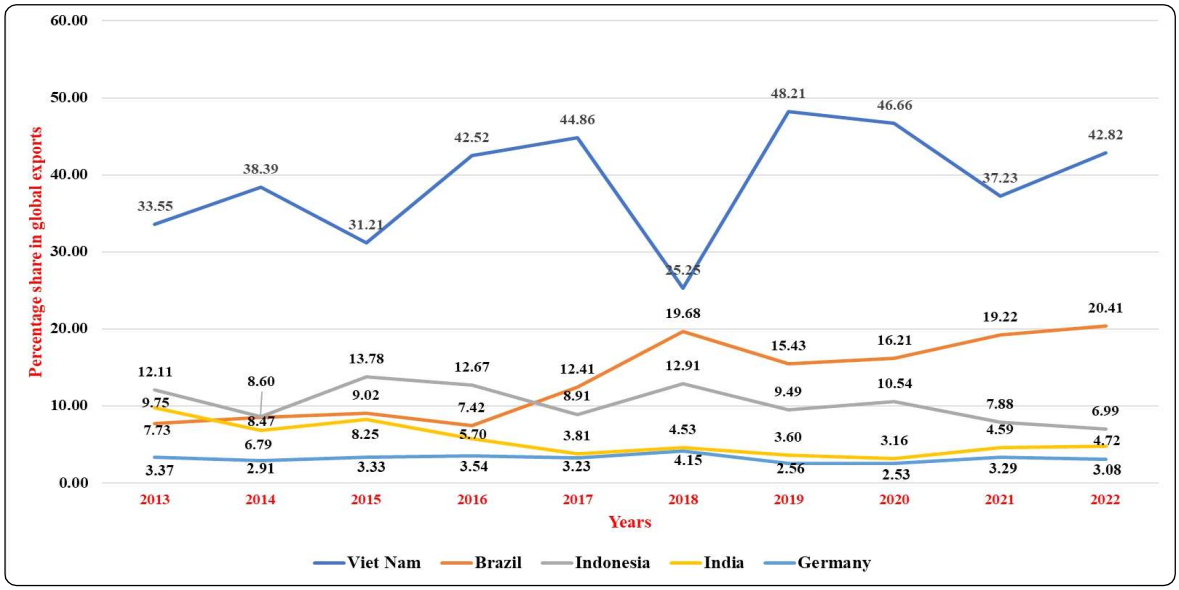

Fig. 1 : Trends in exports share of major pepper exporting countries in global trade

Table 4

Export Unit Value Index (EUVI) of major exporters of pepper in global trade

Exporters	EUVI of Raw pepper (HSC- 090411)	EUVI of Processed pepper (HSC- 090412)	Overall EUVI
Vietnam	4.73	5.72	3.77
Brazil	3.59	2.08	3.58
Indonesia	4.97	6.07	4.82
India	4.72	5.02	3.11
Germany	5.62	6.12	3.77

In the exports of processed pepper (HSC-090412), Germany and Indonesia had highest EUVI of 6.12 and 6.07, indicating that processed pepper exports of these countries are priced significantly higher. Vietnam and India had moderate EUVIs of 5.72 and 5.02, for processed pepper, respectively, indicating that export price for processed pepper is lower than that of Germany and Indonesia. Brazil had the lowest EUVI of 2.08, which indicated a lower unit value for its processed pepper exports, possibly due to lower processing standards or different market dynamics.

The overall EUVI considering both raw and processed pepper, showed that Indonesia with an index value of 4.82 stood first, reflecting its strong performance in exporting both types of pepper at relatively higher prices. Germany and Vietnam both had an overall EUVI of 3.77, suggesting that their average export values across both categories are relatively high but more balanced between raw and processed pepper. India's overall EUVI of 3.11 was the lowest among the major exporting countries, indicating that India exported pepper at a lower price, which might be compensating with larger volumes or targeting different market segments. Brazil's overall EUVI was 3.58, reflecting its lower export unit values, particularly in processed pepper, which affected its overall index.

Revealed Comparative Advantage (RCA) and Revealed Systematic Comparative Advantage (RSCA) of Major Exporters of Pepper

Table 5, presents the Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA) of major exporters of pepper *i.e.,* Vietnam, Brazil, Indonesia, India and Germany from 2018 to 2022. Vietnam had shown a significant comparative advantage in the export of pepper over the last five years, as evidenced by its consistently high RCA values, which peaked at 31.26 in 2018, but showed a gradual decline to 22.74 by 2022. Vietnam's RSCA values remained consistently high (above 0.90), reinforcing its strong competitive position in the global market, although the slight

Table 5

Revealed Comparative Advantage (RCA) and Revealed Systematic Comparative Advantage (RSCA) of major exporters of pepper in global trade

	Exports	2018	2019	2020	2021	2022
Vietnam	RCA	31.26	29.65	24.83	26.98	22.74
	RSCA	0.94	0.93	0.92	0.93	0.92
Brazil	RCA	8.56	9.38	9.80	11.01	10.93
	RSCA	0.79	0.81	0.82	0.83	0.83
Indonesia	RCA	8.90	10.34	10.96	7.27	5.99
	RSCA	0.80	0.82	0.83	0.76	0.71
India	RCA	2.91	2.91	2.70	2.52	2.53
	RSCA	0.49	0.49	0.46	0.43	0.43
Germany	RCA	0.61	0.53	0.54	0.51	0.54
	RSCA	- 0.25	- 0.31	- 0.30	- 0.33	-0.30

decline over time suggests a marginal decrease in its comparative advantage. Brazil's RCA values indicated a growing comparative advantage, increasing from 8.56 in 2018 to 11.01 in 2021, before slightly decreasing to 10.93 in 2022. The RSCA values for Brazil also showed a steady improvement from 0.79 to 0.83, reflecting a strengthening comparative advantage.

Indonesia, like Vietnam, had high RCA value of 8.90 in 2018, which increased to 10.96 in 2020, showing a strong comparative advantage. However, the RCA value decreased significantly to 5.99 by 2022, indicating a reduction in comparative advantage. This decline was also reflected in the RSCA values, which fell from 0.83 in 2020 to 0.71 in 2022, suggesting a weakening comparative advantage. India, with RCA values ranging from 2.52 to 2.91 over the last five years, showed a moderate comparative advantage. However, its RSCA values decreased from 0.49 in 2018 to 0.43 in 2022, indicating a slight decline in its comparative advantage over time in the study period.

Germany, unlike the other countries, consistently showed the RCA values below 1, indicating a comparative disadvantage in the exports of pepper. Its negative RSCA values, ranging from -0.25 to -0.33, further confirm that Germany does not have a comparative advantage in the exports of pepper. Overall, it was revealed that Vietnam and Brazil maintained strong comparative advantage, competitiveness of Indonesia and India weakened slightly and Germany remained at a comparative disadvantage in the export of pepper during the study period. These findings are in line with Thomas and Sanil (2019), who reported that, India has been losing its comparative advantage in world pepper market, especially after the trade liberalisation.

Pepper Exports of India

Table 6 shows the top export destinations for Indian pepper, providing insights into the average import volume, market share, growth trends and import stability for each country. The USA has been the largest importer of Indian pepper (Paul, 2023) with an average import volume of 8,806.6 tonnes, accounting for 36.89 per cent of India's total pepper exports during the study period. Despite being the largest market for Indian pepper, the exports to USA has witnessed a significant decline with CAGR of -8.4 per cent. The UK with an average import share of 7.11 per cent had also seen a significant decline in its imports of Indian pepper with a CAGR of -7.14 per cent indicating a consistent downward trend. Germany and Spain also experienced significant decreases in their imports of Indian pepper, with CAGR of -11.85 per cent and -15.70 per cent, respectively. These trends indicated a shrinking market for Indian pepper in several European countries.

Table 6

Top export destinations for Indian pepper during 2013-2022

Importers	Average imports (tonnes)	Import share (%)	CAGR (%)	CDVI
USA	8806.6	36.89	-8.49 *	24.12
UK	1697.1	7.11	-7.14 **	13.51
Germany	970.9	4.07	-11.85 **	39.94
Canada	962.5	4.03	3.64	23.08
Sweden	877.3	3.68	8.32 *	19.16
Spain	860.8	3.61	-15.70 *	39.91
Netherlands	785.5	3.29	-10.72	61.64
Japan	582.7	2.44	-5.53 **	14.27
Russia	566.7	2.37	-5.56	58.46
Australia	500.7	2.10	1.09	16.76

Note : **, * indicates significance at one and five per cent, respectively

Conversely, Sweden had shown positive and significant growth of 8.32 per cent in its imports of Indian pepper, suggesting an increasing demand for pepper in this market. Canada and Australia also recorded positive growth rates (3.64 and 1.09%) in their imports of Indian pepper, indicating steady demand in these markets. Japan and Russia, despite being smaller markets for Indian pepper with import shares of 2.44 per cent and 2.37 per cent, respectively, had experienced slight declines in their import volumes, though only Japan's decline was statistically significant.

The results of CDVI indicated that USA, Germany, Canada, Spain, Netherlands and Russia had shown high instability in the imports of Indian pepper. Meanwhile, Sweden and Australia showed moderate instability in the imports of Indian pepper. United Kingdom and Japan with CDVI values of 13.51 and 14.27, showed relatively lower instability in imports of Indian pepper.

Table 7

Export market concentration – Hirschman-Herfindahl Index for the Indian Pepper Exports

Importing nations	Average imports (tonnes)	Square of the export share
USA	8806.6	0.13611
United Kingdom	1697.1	0.00505
Germany	970.9	0.00165
Canada	962.5	0.00163
Sweden	877.3	0.00135
Spain	860.8	0.00130
Netherlands	785.5	0.00108
Japan	582.7	0.00060
Russia	566.7	0.00056
Australia	500.7	0.00044
Others	7260.0	0.09250
World	23870.8	-
		Hirschman-Herfindahl Index = 2422.75

Market Concentration of Indian Pepper Exports

The Hirschman-Herfindahl Index (HHI) for Indian pepper exports of 2422.75 indicated a moderate market concentration (Table 7). The majority of Indian pepper exports were concentrated in a few key markets with USA being the major importer, accounting for a significant share of exports, as reflected in its high square of the export share (0.13611). More reliance on a limited number of countries could pose risks to market stability and competitiveness.

To enhance market competitiveness and reduce vulnerability, it would be beneficial for Indian pepper exporters to diversify their markets and reduce their dependence on a few major importing nations. As an alternate measure to study the relationship among the trading partners Soujanya *et al.* (2023) used trade intensity index to indicate whether a country exports more, as a percentage, to a partner than the world does on an average.

Export Destination Dynamics of Indian Pepper Exports

The dynamics and shifts in the pattern of trade in the Indian pepper was analyzed by employing the first order Markov chain approach using time series data from 2012-13 to 2022-23. The probability of retention of previous market share of a trading partner and trend in the existing markets and the gains or losses in the export share of pepper from India by the major importing countries was analyzed and interpreted by the elements of transitional probability matrix.

The transitional probability matrix presented in Table 8 indicated that USA was one of the most stable and reliable importers of Indian pepper with higher probability retention value of 0.726, *i.e.*, the probability that USA retained its export share from India from 2012-13 to 2022-23 was 72.6 per cent. USA being the major importer from India, had also considerably gained from Spain (72. 9 %) over the previous years' import share. Besides, USA would lose its share of 17 per cent to Netherlands and 7.3 per cent to Spain. Further, Canada was found to be another stable importer of Indian pepper, as it had retained its original share of 63.2 per cent over the period, it has gained from Netherlands (41.1 %) and Germany (12.0 %) and also lost its share to UK (12.7 %) and Spain (10.7 %). Russia was also found to be another stable importer of Indian pepper had retained its original import share of 15.1 per cent and has gained from Spain (16.2 %).

Further, it was noted that the countries pooled under the 'others' category import pepper from India in smaller quantities had 21.5 per cent probability of retention of its original share, next to USA (72. 9 %), and Canada (63. 2 %), which were the leading importers of the Indian pepper. 'Others' include Italy, Bangladesh, Malaysia and Poland which were

TABLE 8

Transitional probability matrix of Indian pepper exports

Country	USA	UK	Germany	Canada	Sweden	Spain	Netherlands	Japan	Russia	Australia	Others
USA	0.726	0.000	0.000	0.000	0.000	0.073	0.171	0.025	0.005	0.000	0.000
UK	0.000	0.000	0.320	0.000	0.488	0.000	0.000	0.187	0.005	0.000	0.000
Germany	0.000	0.541	0.000	0.120	0.022	0.000	0.094	0.000	0.000	0.000	0.223
Canada	0.014	0.127	0.104	0.632	0.000	0.107	0.000	0.000	0.000	0.016	0.000
Sweden	0.000	0.115	0.378	0.000	0.000	0.000	0.000	0.000	0.021	0.000	0.485
Spain	0.729	0.000	0.000	0.000	0.000	0.109	0.000	0.000	0.162	0.000	0.000
Netherlands	0.000	0.000	0.000	0.411	0.000	0.000	0.000	0.000	0.000	0.234	0.355
Japan	0.000	0.205	0.053	0.000	0.295	0.000	0.158	0.004	0.012	0.000	0.274
Russia	0.000	0.000	0.000	0.000	0.000	0.849	0.000	0.000	0.151	0.000	0.000
Australia	0.000	0.000	0.000	0.000	0.159	0.841	0.000	0.000	0.000	0.000	0.000
Others	0.000	0.239	0.145	0.090	0.000	0.000	0.000	0.000	0.000	0.312	0.215

engaged in pepper trade with India over the years, could retain their original share with a gain of 48.5, 35.5 and 27.4 per cent from Sweden, Netherlands and Japan, respectively.

The perusal of the Table 8 indicated that USA followed by Canada and Russia are the stable and loyal importers of pepper of from India. Based on Markov chain approach, it is suggested that India should concentrate on stable and reliable markets like USA, Canada and Russia for the export of pepper and also countries like Russia and Spain were found unstable importers, hence necessary steps should be taken to increase exports to these countries. Dasari and Venkataramana (2023) used Markov chain approach to study the dynamics in the direction of exports and the changing pattern in the trade of silk and silk products from India by shift in export shares from one country to another over a period of time, the study found that USA was one of the most stable markets among the major importers of Indian silk and silk products as reflected by the higher probability of retention at 0.751, *i.e.,* the probability that USA retains it sex port share over the study period was 75.16 per cent. Thus, concluding that USA was one of the loyal markets of Indian silk trade.

Overall, India remains a key player in the global spice market, but the declining trend in pepper exports is a cause for concern. India's pepper export performance is facing challenges due to declining export quantities and competitiveness. The findings revealed that Indian pepper was undervalued in the global market and the concentration of exports in a few countries, highlighted by the Hirschman-Herfindahl Index, poses risks to market stability and competitiveness. It is also found that USA, Canada and Russia were the loyal importers of Indian pepper. It highlights the need for diversification to mitigate risks associated with market dependence and also necessitates diversifying the market for Indian pepper. With concerted efforts from both the government and industry stakeholders, addressing the issues of quality, market concentration, and competitiveness through strategic policy interventions can help India reclaim its position in the global pepper trade.

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