Original Research Article

Assessing Export Competitiveness and Trade Patterns of Fresh and Chilled Gherkins from India

ABSTRACT

India is the largest producer and exporter of fresh and chilled gherkins globally, with significant contributions from Karnataka, Tamil Nadu and Andhra Pradesh, accounting for 25–27 per cent of global exports and generating over $200 million annually. This study analysed the trade direction of Indian fresh and chilled gherkins using secondary data (2011–12 to 2022–23) from APEDA, DGCIS, and other sources. The Nominal Protection Coefficient (NPC) was employed to assess export competitiveness, while the first-order Markov chain approach analysed trade direction. The NPC results indicated that Kuwait was a less competitive market (0.98), Bahrain and Oman were moderately competitive (0.85 each), while the UAE, Qatar, Bhutan and Maldives were highly competitive markets (0.30, 0.27, 0.04 and 0.06, respectively). Bhutan, Qatar and the UAE emerged as the most reliable importers, retaining 100 per cent, 73.95 per cent and 68.69 per cent of their market shares, respectively. The study suggest that the UAE, Qatar, Bhutan and Maldives were the most remunerative markets during the study period. However, the high concentration of exports in a few markets increases trade risks, emphasizing the need for market diversification. Strategic interventions, including pricing alignment and enhanced domestic production promotion, are recommended to boost exports and ensure long-term sustainability.

Keywords: Gherkins; Export competitiveness, Direction of Trade, Markov chain, Nominal Protection Coefficient.

I. INTRODUCTION

India is one of the largest producer and exporter of agricultural commodities, and among these, fresh and chilled gherkins have gained significant prominence in global markets. Gherkins, also known as pickling cucumbers, are primarily exported to destinations such as the United Arab Emirates, Qatar, Bhutan and other regions. India's agro-climatic conditions, coupled with an extensive contract farming network, have positioned the country as a competitive player in the global gherkins trade. In 2022, India exported approximately 2,50,000 metric tons of gherkins, generating a revenue of around USD 200 million. Despite such achievements, the sustainability of India's market position faces challenges, including fluctuating demand, rising production costs and competition from emerging exporters like China and Vietnam.

The study of export competitiveness and trade patterns of fresh and chilled gherkins from India becomes critical in this context. Export competitiveness refers to a country's ability to produce and sell goods in international markets at prices, quality and consistency that are favorable relative to its competitors. Direction of trade analysis explores the geographical and temporal dynamics of exports, helping to identify trends, diversification opportunities and emerging challenges in the trade landscape. The gherkins industry in India has shown impressive growth of Compound Annual Growth Rate (CAGR) of 4.64 per cent per annuam (Gunadal *et al*, 2024), but its export dynamics are marked by volatility. Markets that once accounted for a significant share of India's gherkins export, such as Eastern Europe, have shifted focus due to changes in tariffs, quality standards and trade preferences. Additionally, increasing competition from global players, coupled with challenges like currency fluctuations and compliance with stringent phytosanitary regulations, poses a threat to India's sustained competitiveness. Despite the growing importance of gherkins in India's agricultural export portfolio, there is limited literature that comprehensively examines the export competitiveness and directional shifts in trade. This gap highlights the need for an in-depth analysis that not only evaluates India's comparative advantages but also provides actionable insights into emerging markets and trade patterns.

Understanding export competitiveness and trade direction is vital for policymakers, industry stakeholders and exporters. Strategic market insights with shifting geopolitical and

trade dynamics, identifying reliable and high-growth markets can help exporters mitigate risks and enhance profitability. Analyzing factors that influence competitiveness can aid policymakers in designing targeted interventions, such as subsidies for high-quality production, infrastructure development and negotiation of favourable trade agreements. To remain a global leader, India must not only consolidate its market share in existing destinations but also diversify its export portfolio to new regions. Insights from this study can guide value chain improvements, promoting Indian gherkins as premium products and creating a distinct global identity. The gherkin industry supports millions of farmers through contract farming models. Enhancing exports directly contributes to rural employment and income generation. This study seeks to bridge the knowledge gap by employing robust methodologies to evaluate the competitiveness of India's fresh and chilled gherkins exports and identify trends and opportunities in trade direction. By doing so, it aims to provide a roadmap for sustainable growth in this sector.

II. METHODOLOGY

The study was based on secondary data. The data pertaining to the export of gherkins (2011-12 to 2022-23) from India were collected from Agricultural and Processed Food Products Export Authority (APEDA), DGCIS websites and other published sources and data was analysed using Nominal Protection Coefficient (NPC) for export competitiveness and first order markov chain technique was employed to analyses the direction of trade fresh and chilled gherkins from India.

Trade competitiveness basically depends upon the level of domestic prices relative to international prices. Comparative advantage in the gherkins prices encompasses the entire economic process of gherkins production to its export. The degree of comparative advantage in both gherkins production and export influences a country's international competitiveness. In order to reveal trade competitiveness of Indian gherkins in the world market the Nominal Protection Co-efficient (NPC) was used.

Nominal Protection Co-efficient (NPC)

NPC is a direct measure of competitiveness of a country towards a commodity in the context of free trade. The NPC is defined as the ratio of the domestic price to the world reference price of the commodity under consideration.

Symbolically,

$$\mathbf{NPC} = \frac{\mathbf{P_d}}{\mathbf{P_r}}$$

Where,

NPC = Nominal Protection Coefficient

P_d = Domestic price of the commodity

P_r = Respective countries reference market price of the commodity

The decision criterion is, if NPC is less than one, then the commodity is competitive (under importable hypothesis it is considered a good import substitute and under exportable hypothesis, it is worth exporting). If NPC is greater than one, the commodity is not competitive (not a good import substitute or not worth exporting).

Table 1: Tabular representation of Nominal Protection Coefficient (NPC)

Sl. No.	Particulars	Unit	Major Importing Countries			
			1	2	3	4
1.	Wholesale price	₹/kg				
2.	Marketing margin (5%)	₹/kg				
3.	Port clearing & handling charges	₹/kg				
4.	Freight on Board Price (1+2+3)	₹/kg				
5.	Freight charge	₹/kg				
6	Insurance at 2 % of price	₹/kg				
7.	Landed cost (4+5+6)	₹/kg				
8.	Exchange rate	1$ = ₹				
9.	Domestic price (Cost, Insurance and Freight) (row 7 / row 8)	US $/kg				
10.	Reference market price	US $/kg				
11.	NPC (row 9/row 10)					

Source: Udhayan et al, (2023)

The domestic price is normally the wholesale market price of commodity in the selected market. The reference market price is the international price adjusted for transfer cost, marketing and trading margins including the processing charges necessary to make the commodity equivalent to the internationally traded commodity.

Direction of Trade

The major fresh and chilled gherkins importing countries from India were United Arab Emirates, Qatar, Bhutan, Kuwait, Maldives, Baharain Is and Oman. The trade directions

of Indian gherkins were analyzed using the first order Markov chain approach. The LP Solver software was used to analyze the transition probability matrix. Central to markov chain analysis is the estimation of the transitional probability matrix 'P' whose elements, P_{ij} indicate the probability of exports switching from country 'i' to country 'j' over time. The diagonal element P_{ij} where i=j, measures the probability of a country retaining its market share or in other words, the loyalty of an importing country to a particular country's exports.

Annual export data for period 2011-12 to 2022-23 was used to analyze the direction of trade and changing pattern of Indian fresh and chilled gherkins export. In this context, major gherkins importing countries and others were considered. The average exports to a particular country was considered to be a random variable which depends only on the past exports to that country, which can be denoted algebraically as (Udhayan *et al.*, 2023)

$$E_{jt} = \sum_{i=1}^{n} [E_{i\,t-1} \times P_{ij} + e_{jt}]$$

Where,

E_{jt} = Exports from India to the j^{th} country in the year "t"

$E_{i\,t-1}$ = Exports or import to i^{th} country during the year t-1

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

e_{jt} = The error term which is statistically independent of E_{jt-1}

n = The number of importing countries

The transitional probabilities P_{ij}, which can be arranged in a (c x n) matrix, have the following properties.

$$\sum_{i=1}^{n} P_{Ij} = 1 \text{ and } 0 \leq P_{Ij} \leq 1$$

Thus, the expected export share of each country during period 't' is obtained by multiplying the exports to these countries in the previous period (t-1) with the transitional probability matrix. The probability matrix was estimated for the period 2011-12 to 2022-23.

Thus, transitional probability matrix (T) was estimated using linear programming (LP) framework by a method referred to as minimization of Mean Absolute Deviation (MAD).

Min, OP* + I e

Subject to

X P* + V = Y

GP* = 1

P* ≥ 0

Where,

P* is a vector of the probabilities P^{i}_{j}

P* vectors were arranged to obtain the TPM

O is the null vector

I is an appropriately dimensioned vector of export or import.

e is the vector of absolute errors (IUI)

Y is the vector of exports to each country.

X is a block diagonal matrix of lagged values of Y

V is the vector of errors

G is a grouping matrix to add the row elements of P arranged in P* to Unity.

III. RESULT AND DISCUSSION

Export competitiveness of Indian fresh and chilled gherkins to major destinations during 2023-24

The estimation of the NPC for fresh and chilled gherkins under exportable hypothesis for the year 2023-24 is presented in Table 2, The estimated nominal protection coefficients under exportable hypothesis for gherkins were below one in case of all the major importing countries from India. The NPCs for United Arab Emirates, Qutar, Bhutan, Kuwait, Maldives, Baharain IS and Oman were 0.30, 0.27, 0.04, 0.98, 0.60, 0.85 and 0.85 respectively for the period 2023-24. Thus, it is inferred that exports of fresh and chilled gherkins to these trade destinations are efficient and competitive. The outcomes of this study revealed that the hypothesis which states that there is a significant competitiveness in gherkins export has been proven and hence, accepted.

Export competitiveness is often measured through various indicators, such as market share, export growth rate and trade balance. It is essential for countries and industries to continually assess and improve their export competitiveness to thrive in the global economy. The cost of production, including factors such as labour, raw materials, energy and transportation plays a significant role in determining the competitiveness of a product. Competitive prices make products more attractive to foreign buyers. The quality of products, adherence to international standards and compliance with regulations are essential for gaining the trust of international customers. Unique features, branding and value-added aspects that distinguish a product from competitors can enhance its competitiveness. Favorable trade

policies, including tariffs, subsidies and trade agreements, can impact a country's export competitiveness.

Table 2: Export competitiveness of Indian gherkins (Fresh/Chilled) to major destinations during 2023-24

Sl. No.	Particulars	Unit	United Arab Emirates	Qatar	Bhutan	Kuwait	Maldives	Baharain Is	Oman
1	Wholesale price (Bengaluru)	₹/q	3790	3790	3790	3790	3790	3790	3790
2	Marketing margin (5%)	₹/q	189.5	189.5	189.5	189.5	189.5	189.5	189.5
3	Port clearing & handling charges	₹/q	132.5	132.5	132.5	132.5	132.5	132.5	132.5
4	FOB Price (1+2+3)	₹/q	4112	4112	4112	4112	4112	4112	4112
5	Freight charge	₹/q	550	201.95	135.44	231.35	142.1	206.85	166.88
6	Insurance at 2 % of price	₹/q	82.24	82.24	82.24	82.24	82.24	82.24	82.24
7	Landed cost (4+5+6)	₹/q	4744.24	4396.19	4329.68	4425.59	4336.34	4401.09	4361.12
8	Exchange rate (10/04/2024)	$ = ₹	82.52	82.52	82.52	82.52	82.52	82.52	82.52
9	CIF price (row 7 / row 8)	US $ / q	57.49	53.27	52.47	53.63	52.55	53.33	52.85
10	Reference price	US $ / q	194.41	194.34	1203.19	54.55	815.11	62.5	62.5
11	NPC of (row 9/row 10)		0.30	0.27	0.04	0.98	0.06	0.85	0.85

Note: FOB: Freight on Board: CIF: Cost, Insurance and Freight

Currency exchange rates influence the relative cost of a product in international markets. A weaker currency in destination countries can enhance export competitiveness. Government initiatives, incentives and support for exporters can enhance their competitiveness on the global stage.

Direction of trade of fresh and chilled gherkins from India to different destinations (2013-14 to 2022-23)

The pattern and flow of products and services between different countries is referred to as trade direction. It usually referred to the direction of exports and imports, indicating whether a country exports or imports the products and services of the destination countries. Trade directions can vary widely between countries and alter over time due to a variety of reasons such as economic situations, government policies, trade agreements and technological improvements. Some countries specialize in exporting specific commodities or services, while others rely significantly on imports to meet internal needs. The structural variations in India's gherkins export share to key destinations, including the United Arab Emirates, Qatar, Bhutan, Kuwait, Maldives, Baharain IS, Oman, and others, were analyzed using a first-order Markov chain model. A transitional probability matrix was developed to examine the real quantity of exports to these importing countries across different years in the time series.

Transitional probabilities were applied to analyze trade directions. The diagonal elements of the transitional probability matrix indicated the likelihood of retaining market share from the previous period, while the row elements represented the probability of trade loss to competing countries. The column elements reflected the likelihood of gaining trade from rival nations.

Table 3, displays the transitional probability matrix for Indian fresh and chilled gherkins exports, offering detailed insights into the changes in trade patterns over the study period, which spans from 2013-2014 to 2022-2023. This matrix captures the directional shifts in gherkins exports to various key markets during these years. The major importing countries represent the primary destinations for Indian gherkins exports. To provide a clearer understanding of the overall trade dynamics, exports to all other nations outside of these major destinations were combined under a broad category labeled "Others." This grouping allows for a more focused analysis of the key markets, while still accounting for exports to less prominent destinations. The transitional probability matrix effectively highlights the

evolving trends in export shares and trade directions for Indian gherkins, offering a comprehensive view of market retention and potential shifts in global trade over the studied period.

Table 3 illustrates the findings from the transitional probability matrix regarding Indian gherkins (Fresh/Chilled) exports. According to the matrix, about 73.95 per cent of India's previous gherkins exports to Qatar were retained throughout the study period, which covers 2013-2014 to 2022-2023. This indicates a strong consistency in Qatar's import demand for Indian gherkins. The remaining 26.05 per cent of the previous export share was redistributed to other markets, specifically Oman, Baharain IS and Bhutan. The redistribution was as follows: 15.17 per cent of the previous export share went to Oman, 9.38 per cent to Baharain IS and 1.50 per cent to Bhutan. This shift highlights a partial reallocation of export shares from Qatar to these other destinations. In addition, the matrix revealed that Qatar gained approximately 71.48 per cent of its market share from Baharain IS during the study period. This suggests a notable shift in market dynamics, where Qatar increased its import volume of gherkins at the expense of Baharain IS. Bhutan emerged as the most consistent importer of Indian fresh/chilled gherkins, with a 100 per cent probability of retaining its share throughout the study period. This high retention rate underscores Bhutan's strong and unwavering demand for Indian gherkins, reflecting a stable and reliable market for these exports. The United Arab Emirates (UAE) retained 68.69 per cent of its previous export share and it loses 31.31 per cent of its share to Qatar, Kuwait, Maldives, Baharain Is, Oman and others. Whereas, UAE gained 98.73 per cent from countries which are listed under the "others" category. This shows that, UAE was the third most loyal country to Indian fresh/chilled gherkins.

The changes in export of Indian gherkins (Fresh/Chilled) to different destinations were analyzed by Markov chain model. According to Table 3, in terms of export reliability, Bhutan, Qatar and United Arab Emirates were the most faithful among gherkins (Fresh/Chilled) importers, as evidenced by higher probabilities of retention 1.00, 0.73 and 0.68 per cents, correspondingly, implying that Bhutan retained its export share of 100 per cent, Qatar retained 73 per cent and United Arab Emirates retained its share of 68 per cent

from prior period. Higher probabilities of these countries indicate that these countries were more reliable and loyal in importing gherkins (Fresh/Chilled) from India.

Table 3: Direction of trade of gherkins (Fresh/Chilled) from India to different destinations (2013-14 to 2022-23)

Destinations	LOSS →								GAIN ↓
	United Arab Emirates	**Qatar**	**Bhutan**	**Kuwait**	**Maldives**	**Baharain Is**	**Oman**	**Others**	
United Arab Emirates	**0.6869**	0.0474	0.0000	0.0038	0.0149	0.0058	0.0065	0.2348	
Qatar	0.0000	**0.7395**	0.0150	0.0000	0.0000	0.0938	0.1517	0.0000	
Bhutan	0.0000	0.0000	**1.0000**	0.0000	0.0000	0.0000	0.0000	0.0000	
Kuwait	0.0000	0.0000	0.0000	**0.0000**	0.0000	1.0000	0.0000	0.0000	
Maldives	0.0000	0.0335	0.0000	0.0000	**0.0036**	0.0000	0.0000	0.9628	
Baharain Is	0.0000	0.7148	0.0000	0.0000	0.0900	**0.0000**	0.1952	0.0000	
Oman	0.0000	0.0000	0.1074	0.7002	0.0772	0.0000	**0.1152**	0.0000	
Others	0.9873	0.0000	0.0000	0.0012	0.0115	0.0000	0.0000	**0.0000**	

Destination like Oman were relatively unstable with lower probability of 11 per cent. Kuwait, Maldives, Baharain IS and Others were emerged as least loyal importer of Indian fresh and chilled gherkins with no retention or negligible retention.

India has been a major supplier of fresh and chilled gherkins to Bhutan, Qatar and United Arab Emirates due to its proximity and trade agreements. The United Arab Emirates has been an important market for Indian gherkins exports, often serving as a transshipment point for re-exports to other countries. India has supplied fresh and chilled gherkins to Bhutan as part of bilateral trade agreements. It's important to note that India's fresh and chilled gherkins trade can fluctuate based on global market conditions and various factors that influence supply and demand in the international market. The increase in fresh and chilled gherkins exports has been made possible by the APEDA's numerous activities, including the organization of business to business shows in various nations, the exploration of new potential markets and the launch of marketing campaigns with active participation from Indian Embassies. COVID-19 pandemic has significantly affected the worldwide supply of gherkins. At the time of pandemic trade was distracted due to export ban and SPS measures. These results are aligned with (Gunadal *et al*, 2024) direction of trade for fresh and chilled gherkins exports from India: An analysis of global market destinations.

IV. CONCLUSION

India is the world's largest producer and exporter of gherkins, with significant contributions from southern states like Karnataka, Tamil Nadu, and Andhra Pradesh, and exports accounting for 25–27 per cent of global trade, earning over $200 million annually. This study aims to analyse the trade direction of fresh and chilled gherkins from India to various international markets to enhance market identification, competitiveness, and strategic growth. The study utilized secondary data from APEDA, DGCIS and other sources, analysing Indian gherkins exports (2011–12 to 2022–23) using the Nominal Protection Coefficient (NPC) to evaluate export competitiveness and the first-order Markov chain approach to assess trade direction. NPC measured the competitiveness of gherkins based on domestic and international prices, while the Markov chain analysis, supported by LP Solver, estimated transitional probabilities to understand export dynamics and market loyalty across

major importing countries. The result of NPC with respect to Kuwait suggested that less competitive market with NPC value of 0.98. Baharain IS and Oman was found to be moderately competitive markets with NPC value of 0.85 and 0.85 respectively. United Arab Emirates, Quatar, Bhutan and Maldives were found to be highly competitive market with NPC value of 0.30, 0.27, 0.04 and 0.06. Hence, United Arab Emirates, Quatar, Bhutan and Maldives were the most remunerative markets among the studied ones to which fresh/chilled gherkins was exported during the study period. With respect to reliability of export, Bhutan, Quatar and United Arab Emirates were the most loyal importers of fresh/chilled gherkins from India as reflected by higher probability of 1.00, .7395 and 0.6869 respectively which means that Bhutan retained its export share of 100 per cent likewise Quatar retained its share by 73.95 per cent and United Arab Emirates retained its share by 68.69 per cent.

The NPC for a study period indicated moderate export competitiveness except for one or two import markets showing high competitiveness for Indian gherkins. Hence, the government may focus on international relative pricing and formulate targeted strategies in consent with the international demand to increase domestic gherkins production through widespread promotion initiatives in the country. The result of Markov chain analysis has indicated that the exports of fresh/chilled gherkins are likely to be concentrated in Bhutan, Quatar and United Arab Emirates. A high dependence on one or two export markets would increase the trade risk in the long run. There is need to diversify the geographical concentration.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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