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Research Paper

Competitiveness of Fruits' and Vegetables' Exports from India

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ABSTRACT

The study aims to evaluate the competitiveness of selected fruits and vegetables in India by using four revealed comparative advantage (RCA) indices from 2001 to 2019 based on International Trade Centre (INTRACEN) database. The results revealed that out of 25 selected fruits and vegetable products, only seven product groups namely onion fresh, cucumber & gherkin, dried vegetables, cooked or uncooked vegetables, cashewnut shelled, guava & mango and tamarind showed comparative advantage in all the RCA indices. While other fruits and vegetables exhibited comparative disadvantage in a few RCA indices. To measure the consistency across different measures of RCAs, the study used three consistency tests, namely, cardinal, ordinal, and dichotomous tests. The findings indicate that the four indices exhibit greater consistency when measured as an ordinal scale, while showing less consistency when measured as cardinal or dichotomous scales. Moreover, stability of these indices was also revealed in the analysis. The study also suggested specific strategies to boost fruits and vegetables products' exports.

HIGHLIGHTS

- A limited number of fruits and vegetable products have a comparative advantage in exports.
- Products like onion fresh, cucumber & gherkin, dried vegetables, cooked or uncooked vegetables, cashewnut shelled, guava & mango and tamarind showed comparative advantage in all the RCA indices in the study period.
- The findings indicate that the four indices exhibit greater consistency under ordinal measure, while showing less consistency under cardinal or dichotomous measures.

Keywords: Fruits, vegetables, revealed comparative advantage, consistency, stability

Exports are a key element of a thriving economy and a crucial aspect of a country's economic growth and development. By providing access to new markets, technologies, and opportunities for productivity improvement, exports help countries to specialize in areas where they have a comparative advantage, thus boosting their competitiveness and driving economic growth. The exports facilitate diversification and the countries can reduce the impact of economic shocks. This reduces the vulnerability of the economy and helps to ensure long-term growth and stability. In India, agricultural exports have been identified as engine

of growth to enhance farm incomes as laid out in Agricultural Export Policy (2018). During 2021-22, agricultural exports crossed USD 50 billion. As per the provisional figures released by Directorate General of Commercial Intelligence and Statistics, the agricultural exports have grown by 19.92 percent during 2021-22 to meet out \$50.21 billion. Due to diversification in the agricultural sector,

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the horticulture sector has become a major source of positive growth for the sector itself and the economy. The intrinsic value of horticultural exports is higher, thus such exports are referred to as high-value exports yielding higher foreign exchange earnings as compared to other traditional exports (Carter *et al.* 1996). Therefore, the Governments in several developing countries have prioritized the development and modernization of horticultural sector as an export diversification and poverty reduction strategy (Van den Broeck and Maertens, 2016).

India's production of horticultural crops, which include fruits, vegetables, spices, and medicinal plants, increased to a record 342.3 million tonnes in 2021-22, up from 145.8 million tonnes in 2000-01.

Owing to this, exports of horticultural products in general, fruits and vegetable products in particular, have increased tremendously during the last two decades. India's trade competitiveness has improved significantly in recent years, but it still faces several trade concerns that need to be addressed.

The country needs to continue its efforts to upgrade its infrastructure, focus on technology and innovation capacities and reduce trade barriers in international markets to increase exports and competitiveness in the global economy. India witnessed quite low growth in fruits and vegetables exports during 2010-19 as compared to 2001-10, except for cashews shelled, guava, mango, fresh onion, and tomato (Table 1). The recent trade policies have aimed to support the development

Table 1: Growth of major exportable fruits and vegetables products

	Export value	Growth in I	ndia's exports (%)¹ Share in world	Ranking in world	
Products	(USD million)	2001-10	2010-19	export (%)	exports	
Fruits						
Cashewnut, shelled	724.5	6.27	-1.04	14.56	2	
Coconut, fresh	57.5	54.02	10.44	15.13	3	
Tamarind etc.,	107.5	16.69	14.33	2.84	6	
Guava, mango etc.,	164.6	32.77	-2.95	5.26	7	
Peaches etc.,	21.5	19.53	3.11	1.99	7	
Grapes, fresh	286.5	26.54	14.44	3.39	11	
Grapes, dried	38.2	74.01	14.81	2.22	12	
Cashewnut, in shell	20.1	-24.34	36.61	0.86	13	
Coconut, dried	8.3	32.32	5.65	1.15	21	
Orange	11.0	-5.36	4.25	0.21	21	
Fruits and nut, frozen	38.3	139.63	13.61	1.37	22	
Watermelon	9.0	29.38	13.49	0.51	25	
Fresh melon	3.7	54.58	34.83	0.23	29	
Pineapple	4.1	12.30	18.54	0.20	32	
Vegetables						
Cucumber and gherkin	71.6	18.15	8.78	52.2	1	
Onion dried	104.6	25.45	5.93	28.23	1	
Onion, fresh	403.7	25.45	-0.31	11.16	3	
Vegetables, preserved	6.9	-2.68	6.16	2.13	7	
Sweetcorn	10.7	48.04	19.33	2.53	11	
Vegetables, dried	30.9	0.08	22.43	1.7	11	
Potato	63.5	39.6	12.42	1.79	13	
Peas, fresh	6.9	56.44	4.62	1.45	14	
Capsicum	34.0	30.26	9.97	0.62	16	
Tomato	22.4	66.98	-8.33	0.24	24	
Vegetables, uncooked or cooked	14.2	25.08	6.57	0.39	27	

Source: Authors' computations based on INTRACEN database.

¹Export performance of selected fruits and vegetable was calculated by estimating compound growth rate of export value for the periods 2001-10 and 2010-2019.



of the agri-food sector and encourage export expansion. Through the implementation of various measures, the government has helped to improve the competitiveness and profitability of the sector. The performance of agricultural exports has always been a focus for policymakers because it is a significant source of foreign exchange, promotes crop diversification, and can improve farm income. In this background, the study focuses on the trade performance of fruits and vegetables and evaluates the consistency and stability of revealed comparative advantages indices.

MATERIALS AND METHODS

The data used in this paper is sourced from the INTRACEN database at the HS six-digit level of classification. The HS six-digit level of classification provides a more detailed classification of goods and allows for a more accurate analysis of trade trends. The data covers the period from 2001 to 2019, providing a comprehensive view of international trade trends over nearly two decades. Accordingly, 25 fruits and vegetable products were identified and analysed for the study (Annexure). To examine the country's comparative advantages, the study utilizes widely accepted approach RCA index i.e., Balassa index (1965), to measure the comparative advantage, which can be expressed as follows;

1. Revealed Comparative Advantage (RCA)

This is the most important measure of comparative trade advantage for country 'i' in product 'j'.

$$RCA_{ij} = \frac{\left(\frac{X_{ij}}{X_i}\right)}{\left(\frac{X_{wj}}{X_{wi}}\right)} \dots (1)$$

Where

 X_{ii} = value of country *i*'s export of product '*j*'

 X_i = value of country i's total export

 X_{wi} = value of world export of product 'j'

 X_{w} = value of world total export

RCA measures a country's exports of a commodity relative to its total exports and to the corresponding exports of a set of countries. A comparative advantage is 'revealed', if RCA>1. If RCA is less than one, the country is said to have a comparative

disadvantage in the commodity. However, it is argued that this index is biased due to the omission of imports especially when country size is important (Greenaway and Milner, 1993).

In order to overcome these deficiencies in this well-known measure, Vollrath (1991) offered mainly three alternative ways of measurement of a country's revealed comparative advantage (RCA), which are used in this study and discussed as follows:

1. Relative Trade Advantage (RTA): The first alternative measure proposed by Vollrath is the difference between the revealed export advantage (RXA) and revealed import advantage (RMA).

$$RCA_{ii}^{1} = RTA_{ii} = RXA_{ii} - RMA_{ii} \qquad \dots (2)$$

$$RXA = \frac{\left(\frac{X_{ij}}{X_i}\right)}{\left(\frac{X_{wj}}{X_w}\right)}, RMA = \frac{\left(\frac{M_{ij}}{M_i}\right)}{\left(\frac{M_{wj}}{M_w}\right)}$$

Where,

 RCA_{ii}^{1} = first measure of comparative advantage

 RXA_{ij} = revealed export advantage for country 'i' in product 'j' = RCA_{ii}

 M_{ii} = value of country i's import of product j

 RXA_{ij} = value of country *i*'s total import

 M_{ii} = value of world import of product 'j'

2. **RCA**²: The second measure is the logarithm of the revealed export advantage and is expressed as:

$$RCA^{2} = ln (RXA_{ij}) \qquad ...(3)$$

Where,

 RCA^2 = second measure of comparative advantage RXA_{ij} = revealed export advantage for country 'i' in product 'j'

3. RCA³: Vollrath proposed the third alternative measure as 'revealed competiveness' (RC) which is expressed as the difference between the logarithm of the relative export advantage and the relative import advantage.

$$RCA^3 = RC = ln (RXA_{ij}) - ln (RMA_{ij})$$
 ...(4)

Where,

 RCA^3 = third measure of comparative advantage RXA_{ij} = revealed export advantage for country 'i' in product 'j'

 RMA_{ij} = revealed import advantage for country 'i' in product 'j'

The positive values of Vollrath's three alternative measures of revealed comparative advantage reveal a comparative advantage, whereas negative values indicate comparative disadvantage.

Consistency and stability test for RCA indices

Ballance et al. (1987) suggest three tests of consistency to assess the robustness of the results obtained from different RCA indices. The first test is a cardinal test based on the correlation coefficient between paired indices over the period, which measures the consistency of the magnitudes of the RCA indices. This test compares the relative magnitude of the RCA indices obtained from different indices and determines the extent to which they are similar. If the indices are consistent, the results obtained from different indices should be proportional to each other. The second test is an ordinal test based on the 'rank correlation coefficient' between paired indices over the years, which measures the consistency of the ranking of products by comparative advantage. The ordinal test compares the rank of products by comparative advantage obtained from different indices and determines the extent to which the rankings are the same. If the indices are consistent, the rank order of products by comparative advantage should be the same regardless of the index used. The dichotomous test measure based on the share of products groups in which both of the paired indices suggest a comparative advantage or comparative disadvantage. Andhale and Kannan (2015) used these tests to evaluate the consistency of their measurement indices in their study. These tests of consistency provide a way to assess the robustness of the results obtained from different RCA indices and determine the extent to which they are consistent in their identification of comparative advantage.

RESULTS AND DISCUSSION

Revealed comparative advantage in fruits and vegetables exports

The study analysed the limited number of fruits and vegetable products, out of 25 selected fruits and vegetable products, only seven products showed comparative advantage in exports, across all indices during the study period. The figures indicated that some products have shown comparative disadvantage in TE 2019, while some have shown comparative disadvantage.

RCA for fruits

The study has examined RCA for 14 selected fruits and fruits products over the study period 2001-19. The perusal of Table 2 indicated that out of 14 selected products, six products have shown comparative advantage during TE 2019. Out of the selected fruits, tamarind, cashew apple etc. alone shows increasing RCAs, while cashewnut shelled, guava, and mango show positive but decreasing RCAs over the study period. However, fresh grapes, fresh coconut and peaches had revealed comparative disadvantage in TE 2003 but comparative advantage in TE 2019.

RCA for vegetables

Intriguingly, India enjoys a sizable comparative advantage when it comes to the export of vegetable products (Table 3). Four of the eleven vegetable products, such as fresh onion, dried onion, cucumber & gherkins and preserved vegetables have shown increasing RCA during the study period. While products like tomato, fresh peas and cooked or uncooked vegetables showed comparative disadvantage throughout the period. Overall, out of 11 selected vegetable products, comparative advantage was observed among eight vegetable groups in TE 2019 when compared with all the RCA indices.

Consistency and stability of revealed comparative advantage

Table 4 displays the findings of the consistency tests for the cardinal, ordinal, and dichotomous of four RCA indices. If the value of correlation coefficient exceeds 0.70, it means there exists consistency



Table 2: Computation of RCA for fruits

Products		TE :		TE 2010				TE 2019				
rroducts	RCA	RCA^1	RCA ²	RCA ³	RCA	RCA^1	RCA ²	RCA ³	RCA	RCA^1	RCA ²	RCA ³
Desiccated coconuts	0.06	0.04	-2.83	1.10	0.19	0.19	-1.65	5.85	0.80	0.33	-0.22	0.53
Coconuts, fresh	0.74	0.74	-0.30	5.03	6.11	6.10	1.81	8.82	10.60	10.59	2.36	6.97
Cashew nuts, in shell	7.96	-44.71	2.07	-1.89	0.14	-29.98	-1.94	-5.34	0.60	-15.23	-0.51	-3.27
Cashew nuts, shelled	34.02	33.98	3.53	6.68	18.44	18.36	2.91	5.42	10.20	9.89	2.32	3.48
Pineapple	0.04	0.04	-3.32	7.35	0.03	0.03	-3.37	5.05	0.14	0.14	-1.99	8.74
Guava, mango and	5.08	5.07	1.62	7.44	12.12	12.11	2.49	8.01	3.69	3.67	1.30	5.64
mangosteens												
Orange	0.22	0.22	-1.50	3.75	0.07	0.01	-2.63	0.18	0.15	-0.10	-1.89	-0.52
Grapes, fresh	0.46	0.45	-0.79	4.07	0.94	0.90	-0.06	3.18	2.37	2.33	0.86	3.97
Grapes, dried	0.02	-0.73	-3.89	-3.60	0.54	0.12	-0.62	0.26	1.55	-0.38	0.44	-0.22
Watermelon	0.07	0.06	-2.71	2.98	0.13	0.13	-2.04	8.12	0.36	0.36	-1.03	8.50
Fresh melon	0.00	-0.01	-6.22	-1.44	0.02	0.01	-4.08	0.80	0.16	0.15	-1.84	3.09
Tamarinds, cashew	1.38	1.36	0.32	4.42	1.46	1.37	0.38	2.86	1.99	1.84	0.69	2.58
apple etc.,												
Fruit and nuts, frozen	0.01	0.00	-5.12	0.46	0.29	0.29	-1.23	4.74	0.96	0.95	-0.04	4.45
Peaches, pear, papaya	0.80	0.77	-0.22	3.09	1.24	1.15	0.21	2.65	1.40	1.30	0.33	2.69
etc.,												

Source: Authors' computations based on INTRACEN database.

Table 3: Computation of RCA for vegetables

D. J. J.	TE 2003				TE 2010				TE 2019			
Products	RCA	RCA ¹	RCA ²	RCA ³	RCA	RCA ¹	RCA ²	RCA ³	RCA	RCA ¹	RCA ²	RCA ³
Potato	0.16	0.15	-1.84	3.63	0.53	0.53	-0.63	7.59	1.25	1.25	0.23	7.16
Tomato	0.02	0.02	-3.72	7.22	0.26	0.26	-1.34	6.97	0.17	0.17	-1.77	10.38
Onions, fresh	5.30	5.30	1.67	11.48	10.21	10.19	2.32	6.43	7.82	7.67	2.06	3.97
Capsicum	0.08	0.08	-2.59	8.15	0.21	0.21	-1.58	5.97	0.44	0.44	-0.83	9.07
Peas, fresh	0.03	0.02	-3.62	1.49	0.35	0.34	-1.06	3.68	1.02	1.02	0.02	9.50
Sweetcorn	0.04	0.02	-3.24	0.52	0.24	0.22	-1.43	2.51	1.77	1.77	0.57	6.01
Vegetables, uncooked or cooked	0.08	0.08	-2.55	5.37	0.14	0.14	-1.97	4.29	0.27	0.27	-1.30	6.33
Cucumber and gherkins, preserved	18.96	18.96	2.94	9.77	33.29	33.27	3.51	7.32	36.58	36.55	3.60	7.31
Vegetables, preserved	1.42	1.41	0.35	4.51	1.03	0.99	0.03	3.24	1.50	1.29	0.40	1.96
Onions, dried	4.45	4.44	1.49	5.68	7.86	7.81	2.06	5.05	19.78	19.74	2.98	6.16
Vegetables, dried	0.40	0.34	-0.90	1.85	0.18	0.08	-1.70	0.60	1.19	1.10	0.18	2.52

Source: Authors' computations based on INTRACEN database.

among RCA indices. This test for the cardinal measure shows that only 5 paired indices out of 18 paired indices exhibit high correlation. As a results, the indices do not appear to be consistent as cardinal measures of revealed comparative advantage. Similar results were obtained for agriculturally processed products of India (Andhale and Kannan, 2015). Furthermore, the test of the indices as dichotomous measures reveals that only half of all indices are consistent as dichotomous measure. Finally, the rank correlation coefficient test, which is used to assess the consistency of the ordinal

measure, demonstrates that all possible paired indices exceed the critical value. The results are fairly matched with the findings of Jagdambe (2019). In other words, the findings indicate that the four indices are more consistent as ordinal measurements as compared to other two measures. This suggests that the RCA measures are valuable indicators in figuring out if India has a comparative advantage or disadvantage with the rest of the globe in terms of vegetables and fruits.

For testing stability of RCA indices, there are several stability tests available in the literature. The

Table 4: Consistency tests of the revealed comparative advantages indices

I., J.,		TE 200		TE 201	0		TE 2019		
Indices	RCA	RCA ¹	RCA ²	RCA	RCA ¹	RCA ²	RCA	RCA ¹	RCA ²
Cardinal to	est								
RCA ¹	0.38			0.71			0.90		
RCA^2	0.69	0.07		0.71	0.67		0.75	0.68	
RCA^3	0.30	0.62	0.33	0.34	0.75	0.62	0.22	0.50	0.17
Ordinal tes	st								
RCA ¹	0.92			0.98			0.95		
RCA^2	1.00	0.92		1.00	0.98		1.00	0.95	
RCA^3	0.88	0.96	0.88	0.91	0.94	0.91	0.85	0.92	0.85
Dichotomo	us test								
RCA ¹	0.93			1.00			0.87		
RCA^2	0.96	0.93		1.00	1.00		1.00	0.87	
RCA^3	0.43	0.50	0.43	0.50	0.50	0.50	0.65	0.68	0.62

Source: Authors' computations based on INTRACEN database.

Table 5: Stability of revealed comparative advantage indices

	RCA TE 2003		RCA ¹ _{TE 2003}		RCA ² TE 2003		RCA ³ TE 2003
RCA _{TE 2010}	0.72595	$RCA^1_{ TE 2010}$	0.85884	$RCA^2_{{}_{TE2010}}$	0.52648	RCA^3_{TE2010}	0.77003
$RCA_{TE\ 2019}$	0.56057	$RCA^1_{ TE 2019}$	0.61234	$RCA^2_{{}_{TE2019}}$	0.60809	$RCA_{\text{ TE 2019}}^{3}$	0.70671

Source: Authors' computations based on INTRACEN database.

results of stability test are presented in Table 5. The correlation coefficient between the RCA indices was determined using TE 2003 as the base year. It was observed that correlation coefficient was higher than 0.70 among four paired indices out of total eight paired indices. This demonstrates that the paired RCA indices have strong stability.

Product positioning of fruits and vegetable products

This section presents the product positioning and categorization of selected fruits and vegetables (F&V) based on their RCAs. Accordingly, all selected F&V products were classified into two categories: (i) Commodities with revealed comparative disadvantage and (ii) Sectors with RCA, and are presented in Box 1.

CONCLUSION

This study provides an in-depth analysis of the competitiveness of fruit and vegetable products in the international market. The study identifies seven products with potential for export and importance for the local economy. The analysis shows that products like onion fresh, cucumber & gherkin,

dried vegetables, cooked or uncooked vegetables, cashewnut shelled, guava & mango and tamarind have a comparative advantage over the study period. In this accordance, the study highlights the importance of quality control measures to ensure that products meet international standards in terms of hygiene, packaging, and labeling. The creation of quality control centers and the provision of technical support to farmers and processors can help achieve this target. The study suggests that the government should investigate and provide incentives and subsidies to encourage the adoption of modern technologies and improve production and processing practices. Infrastructure development is also crucial to enhance transport and storage facilities for the export of horticultural products. By promoting export-oriented value chains and providing support to farmers and processors, the country can increase its competitiveness and achieve its goal of doubling agricultural exports. In summary, the study provides valuable insights into the comparative advantage of various fruit and vegetable products and emphasizes the need for the country to concentrate on commodity-specific strategies to tap the export potential.



Box 1: Strategy matrix for enhancing fruits and vegetables exports

Product positioning of fruits and vegetables products

Commodities with revealed comparative disadvantage

Tomato, Capisum, Vegetables, uncooked or cooked, Coconut dried, Cashewnut in shell, Pineapple, Orange, Grapes, Watermelon, Fresh melon, Fruits and nut, frozen

Commodities with revealed comparative advantage

Onion fresh, Cucumbers and Gherkins, Preserved vegetables, Onions dried, Cashewnut shelled, Guava, mango etc., Tamarind etc., Potato, Fresh pea, Sweetcorn, Dried vegetables, Coconut fresh, Peaches, etc.,

Strategies for boosting fruits and vegetables trade

- Increasing yield through introduction of advanced technology along with high-yielding varieties.
- Improving product quality and ensuring testing facility for compliance towards the sanitary and phyto-sanitary (SPS) and technical barriers to trade (TBT) measures.
- Encouraging farmers' producer organizations (FPOs), for branding and packaging, etc. at farm level to connect farmer to export markets
- Creating global value chains, and introducing cold chain infrastructure to enhance the shelf-life of fruits and vegetables.
- Provision of perishable cargo centre, cargo freight stations for container stuffing, reefer containers, reefer plugs, and scanners close to the port area to provide safe transit of perishable fruits and vegetables

- Promotion of advance technology along with good agricultural practices (GAP) to increase the production capacity to meet the surplus demand.
- Role of APEDA is crucial in emerging export markets.
 Use of policy like one district one product (ODOP) can be advantageous in meeting the export targets.
- For real-time updates on tariff, non-tariff, pesticide & chemical maximum residue limit notifications, an efficient worldwide market intelligence network through an integrated web portal is required.
- Creating dynamic and functional informationsharing mechanism between the State and Centre and ensuring testing facility for SPS and TBT measures.

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ANNEXURE

Product selection of fruits and vegetables products

HS Code	Fruits and vegetables products
′080111	Desiccated coconut
'080119	Fresh coconut, whether or not shelled or peeled (excluding in the inner shell "endocarp")
'080131	Fresh or dried cashew nuts, in shell
'080132	Fresh or dried cashew nuts, shelled
'080430	Fresh or dried pineapple
'080450	Fresh or dried guava, mango and mangosteen
'080510	Fresh or dried orange
'080610	Fresh grapes
'080620	Dried grapes
'080711	Fresh watermelon
'080719	Fresh melons (excluding watermelons)
'081090	Fresh tamarinds, cashew apples, jackfruit, lychees, sapodillo plums, passion fruit, carambola
'081190	Frozen fruit and nuts, uncooked or cooked by steaming or boiling in water, whether or not sweetened
'081340	Dried peaches, pear, papaws "papaya", tamarinds and other edible fruits (excluding nuts,
'070190	Fresh or chilled potato (excluding seed)
'070200	Tomato, fresh or chilled
'070310	Fresh or chilled onion and shallot
'070960	Fresh or chilled fruits of the genus Capsicum or Pimenta
'071021	Shelled or unshelled peas "Pisum sativum", uncooked or cooked by steaming or by boiling.
'071040	Sweetcorn, uncooked or cooked by steaming or by boiling in water, frozen
'071080	Vegetables, uncooked or cooked by steaming or by boiling in water, frozen (exclu. Potatoes)
'071140	Cucumber and gherkin provisionally preserved, e.g. by sulphur dioxide gas, in brine
'071190	Vegetables and mixtures of vegetables provisionally preserved, e.g. by sulphur dioxide gas,
'071220	Dried onion, whole, cut, sliced, broken or in powder, but not further prepared
'071290	Dried vegetables and mixtures of vegetables, whole, cut, sliced, broken or in powder, but not .