J. Farm Sci., 37(1): (59-63) 2024

RESEARCH PAPER

Export of fruits, vegetables and their products from India - A study on growth rate and instability index

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(Received: February, 2023 ; Accepted: March, 2024)

DOI: 10.61475/JFS.2024.v37i1.14

Abstract: The study aimed to analyze the growth rate and instability index for export of fruits, vegetables and products of fruits and vegetables from India. The present study based on the secondary data, data were collected from Agricultural and Processed Food Export Development Authority (APEDA). Compound annual growth rate analysis and cuddy della valle instability index were employed for analysis of growth rate and instability index of fruits, vegetables and products of fruits and vegetables from India. Here secondary data for fruits, vegetables and products of fruits and vegetables was collected for the period of 2006-07 to 2021-22. The results reveals that the CAGR for the export of fruits and vegetables in terms of quantity and value showed a positive and significant growth rate for potato (12.59 and 21.56%), watermelon (11.75 and 21.19%), green chilli (9.03 and 20.70%), other fresh vegetables (8.49 and 15.99%), grapes (8.18 and 18.70%), pomegranate (7.91 and 19.15%), oranges (7.30and 17.98%), garlic (7.26 and 17.61%) and other fresh fruits (7.06 and 16.54%), But mango shows negative growth rate of -5.26 per centin terms of quantity and the highest instability index showed for orangesat 75.53 and 74.42, respectively. For products of fruits and vegetables in terms of quantity and value the CAGR for the export of raisins (41.00 and 50.48%), potato (prepared and preserved) (36.85 and 40.64%), other vegetables products (betel leaves and nuts) (15.28 and 23.09%), processed fruits, juices and nuts (10.15 and 18.76%), onion (dried and powdered) (6.71 and 15.06%), processed vegetables (5.41 and 14.04%), fruits and vegetables seeds (4.79 and 16.93%), guar gum (4.73 and 8.32%), mango pulp (3.63 and 2.33%) and cucumber and gherkins (prepared and preserved) (1.03 and 8.71%). But walnuts shows negative and significant growth rate of -9.97 and -7.51per cent and the highest instability index showed for potato (prepared and preserved) and guar gum at 67.98 and 105.79, respectively. This conclude that there had been absolute growth rate due to increased fruits and vegetables production, growing international demand for fruits, vegetables and products of fruits and vegetables, competitive pricing in global market. By this India can continue to expand its presence in global market, boosting economic growth and benefiting farmers and stake holders across the agricultural value chain and reduce risk of export in future days.

Key words: Compound annual growth rate, Export, Fruits, Instability index, Products of fruits, Vegetables

Introduction

India ranks second in the production of horticultural crops like fruits, vegetables, spices and plantation crops. Fresh and processed fruits and vegetables are more and more in demand on the global market. As per National Horticultural Database during 2021-22, India produced 102.48 and 200.45 million metric tonnes of fruits and vegetables, respectively. The area under cultivation of fruits and vegetables stood at 9.6 million hectares and 10.86 million hectares, respectively. In India, fruits, vegetables and products of fruits and vegetables industry generate around 55 per cent of exports. Consumer tastes have changed from cereals to high-value agricultural produce as a result of rising incomes, urbanisation, shifting lifestyles and worldwide market integration. Farmers can thus profit from agricultural diversification by raising fruits, vegetables and preparing products of fruits and vegetables to satisfy the escalating demand (Ramesh *et al*., 2017). India exports their produce mainly to Bangladesh, Nepal, United Arab Emirates, United Kingdom, Malaysia, Saudi Arabia, Bahrain and Kuwait.

The global economy has gathered an unconventional momentum with the most significant transformation in the field of trade. The liberalised multilateral trade agreements - under the World Trade Organisation (WTO) was one of the significant developments of the 1990s. It has effectively encouraged development through optimal allocation of resources among the economies of the world. As tariff levels have declined through successive GATT/WTO rounds and global supply chains have come to dominate production patterns, growing attention has been directed to the remaining cost factors that are important for international competitiveness, in particular those incurred by trade formalities and procedures. The world is facing food crisis and to overcome it, trade of agricultural products is necessary. The original GATT did apply to agricultural trade, but it contained loopholes. The objective of the Agriculture Agreement is to reform trade in the sector and to make policies more market-oriented. This improved predictability and security for importing and exporting countries alike. The global agricultural trade exists more in industrial countries among trade blocks of European Union and North American Free Trade Agreement. The share of agriculture in global trade has been shrinking, along with its share in global gross domestic product. Most successful developing countries have not depends on agriculture for their exports. The developing countries of the world are capable of becoming the world food basket if provided with better trading opportunities. For countries with a small urban

population, increasing agricultural exports can accelerate growth more than expanding domestic market demand (Afreen, 2018).

Several policy measures were initiated to boost agriculture export namely AEP (Agriculture Export Policy), EPF (Export Promotion Forums) for specific products, and Agri-cells in 13 different countries which are helping in real-time trade data. Furthermore, to combat freight disadvantages relaxed using schemes like TIES (Trade Infrastructure for Export Scheme), MAI (Market Access Initiatives), and TMA (Transport and Marketing Assistance) for agricultural export.

Policies of foreign trade play an important role in the country's economic development, income, employment, and exchange earnings and increase bilateral and multilateral relations at the international level. The trade policy has witnessed several changes in terms of value, composition and direction. These structural changes in international trade were the results of foreign policies which are changing continuously.

India exports more than 8 per cent of the world's coffee, tea and spices, as well as 1.70 per cent to 1.80 per cent of the world's fruits and vegetables and 5.90 per cent of the world's marine products, mostly through focusing on export potential in shrimp and prawn exports. A market share of 3.00 per cent in 2020 for sugar and sugar confectionery (refined sugar, glucose, molasses, boiled sweets and other confectioneries). With only 2.50 per cent of the global market for tobacco exports in 2020, the nation has a negligible presence. However, oil meal, which is made from oil seeds such as soybeans, groundnuts, castor seeds, mustard, colza seeds and other oil seeds etc.are the country's main source of foreign exchange earnings in 2020-21. (Anonymous,2021).Hence, the present study is attempted with the following specific objectives;

To study the growth rate for export of fruits and vegetables from India

To study the growth rate of export of fruits and vegetables products from India

Material and methods

The study was conducted by utilising the time series data on quantity and value of fruits, vegetables and products of fruits and vegetables in India were collected from publication of National Horticultural Board (NHB), APEDA (Agricultural Processed Food Products and Export Development Authority), Agricoop (Agriculture Co-operation and Farmers Welfare, agricoop.nic.in) Books, reports, Journal, periodicals and News Paper etc. for a period of (2006-07 to 2021-22) for fruits, vegetables products of fruits and vegetables.

Average: The mean of data obtained by adding all numbers in the data set and then dividing by the number of values in the set.

$$\text{Average} = \frac{X1+X2+X3\ldots\ldots..+Xn}{N}$$

Where, X1, X2, X3…. Xn = data points

N= Frequency of data set

Coefficient of variations: When the standard deviation is divided by the arithmetic average of the series, the resulting quantity is known as the coefficient of standard deviation and multiplied by 100; the resulting figure is the coefficient of variation. In this study, the coefficient of variation indicates how much volatility in the horticultural exports (2006-07 to 2020-21) period.

Coefficient of variations (C.V.):

$$C.V. = \frac{\text{Standard Deviation}}{\text{Mean}} X\ 100$$

Compound growth analysis

Growth rate was calculated for export of fruits, vegetable and products of fruits and vegetables in India in the present study. Growth rates are measures of performance of economic variables. They are not developed to predict; but describe the trends in variables over time. Hence, these are commonly used as indicators of trends in the time series data. Compound growth rate was estimated with the help of the following exponential model.

$Y = a\ bt\ e$

Where, Y = Dependent variable for which growth rate is estimated.

a = Intercept.

b = Regression coefficient.

t = Time variable.

e = Error term.

The logarithmic form of the above equation estimated the compound growth rate

$\log Y = \log a + t \log b$

The compound growth rate (g) was estimated by using

$g = [\text{Anti log of (b)} - 1] * 100$

Measure of instability

"There are a number of techniques available to measure the index of instability. In this study the instability export of fruit, vegetable and products of fruits and vegetables crops were measured in relative terms by the Cuddy-Della Valle index which is used in recent years by a number of researchers as a measure of variability in time series data"

Cuddy-Della Valle Index (CDVI)

"The simple coefficient of variation over estimates the level of variability in time-series data characterized by long-term trends whereas the Cuddy-Della Valle index corrects the coefficient of variation. The instability index, is given by the expression"

$$C.V. = \frac{\text{Standard Deviation } (\sigma)}{\text{Mean } (x)} X\ 100$$

Linear trend were fitted to the original data of export of selected crops, for the period of 15 years. The trend coefficients

were tested for their significance. Whenever the trend of series found to be significant; the variation around the trend rather than the variation around mean was used as an index of instability. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend. That is Coefficient of variation was multiplied by the square root of the difference between the unity and coefficient of multiple determinations (r^2) in the cases where $r^2$was significant to obtain the Instability Index.

Instability index = $CV \times \sqrt{1-r^2}$

Results and discussion

Growth and instability for export of fresh fruits and vegetables in terms of quantity

The results for the compound annual growth rate and instability index for the export of fruits and vegetables from India in quantity terms for the period from 2006-07 to 2021-22 are presented in Table 1. The data in Table 1 showed that the average of fresh fruits and vegetables exported in terms of quantity were highest for onion (14,91,355.16 metric tonnes) followed by other fresh vegetables (6,11,461.72 metric tonnes), other fresh fruits (3,04,648.80 metric tonnes), potato (2,40,502.21 metric tonnes), tomato (1,55,590.99 metric tonnes), grapes (1,41,239.62 metric tonnes) and mango (54,954.58 metric tonnes) werethe highest quantity exported from India, whereas the lowest quantity of fruits and vegetables exported were oranges (44,437.57 metric tonnes) followed by pomegranate (39,986.09 metric tonnes), green chilli (38,425.43 metric tonnes), lemon (19,373.34 metric tonnes),watermelon (18,254.32 metric tonnes), garlic (16,719.72 metric tonnes) and banana (770.62 metric tonnes).

The compound growth rate for the export of fresh fruits and vegetables in terms of quantity showed a positive and significant growth rate for potato (12.59 per cent), watermelon (11.75 per cent), green chilli (9.03 per cent), other fresh vegetables (8.49 per cent), grapes (8.18 per cent), pomegranate (7.91 per cent), oranges (7.30 per cent), garlic (7.26 per cent) and other fresh fruits (7.06 per cent) due to increased global demand for fruits and vegetables, and also due to the simplification of procedures and removal of quantitative restrictions but mango showed negative growth rate of -5.26 per cent due to more domestic consumption in India.Instability indices for the export of fresh fruits and vegetables in terms of quantity for oranges held the highest instability at 75.53 due to less resources availability for production. Similar results were reported by Sahni (2014).

Growth and instability for export of fruits and vegetables in terms of value

The results for the compound annual growth rate and instability index for the export of fresh fruits and vegetables from India in value terms for the period from 2006-07 to 2021-22 are presented in Table 2. The data in Table 2 showed that the average of fruits and vegetables products exported in terms of value were highest for onion (₹ 2,243.84 crores) followed by other fresh vegetables (₹ 1,420.22 crores), grapes (₹ 1,111.48 crores), other fresh fruits (₹ 1,031.46 crores) pomegranate (₹ 307.21 crores) and potato (₹ 303.50 crores), whereas the lowest value of fresh fruits and vegetables exported were tomato (₹ 290.40 crores) followed by mango (₹ 263.83 crores),green chilli (₹ 38.16 crores), oranges (₹ 102.30 crores), garlic (₹ 54.35 crores) and lemon (₹ 43.47 crores).

The compound growth rate for the export of fresh fruits and vegetables in terms of value showed a positive and significant growth rate for potato (21.56 per cent), watermelon (21.19 per cent), green chilli (20.70 per cent), pomegranate (19.15 per cent), grapes (18.70 per cent), oranges (17.98 per cent), garlic (17.61

Table 1. Growth and instability for export of fresh fruits and vegetables in terms of quantity (2006-07 to 2021-22)
(Quantity-Metric tonnes)

Particulars	Average (%)	CV (%)	CAGR	CDVI
Fresh Fruits				
Banana	770.62	50.81	1.12	52.10
Grape	1,41,239.62	41.37	8.18**	20.36
Lemon	19,373.34	27.27	0.07	28.23
Mango	54,954.58	29.86	-5.26	20.14
Oranges	44,437.57	85.20	7.30*	75.53
Pomegranate	39,986.09	46.77	7.91**	29.40
Watermelon	18,254.32	51.68	11.75**	14.57
Other Fresh Fruits	3,04,648.80	38.94	7.06**	15.84
Fresh Vegetables				
Green Chilli	38,425.43	46.96	9.03**	28.40
Garlic	16,719.72	72.66	7.26*	73.25
Onion	14,91,355.16	26.21	2.42	24.17
Potato	2,40,502.21	52.42	12.59**	22.21
Tomato	1,55,590.99	75.74	6.40	74.30
Other Fresh Vegetables	6,11,461.72	38.00	8.49 **	22.29

Note: ***Significant at 1 per cent, **Significant at 5 per cent, *Significant at 10 per cent

Table 2. Growth and instability for export of fresh fruits and vegetables in terms of value (2006-07 to 2021-22)
(Value - ₹ in Crores)

Particulars	Average	CV (%)	CAGR (%)	CDVI
Fresh Fruits				
Banana	2.07	72.58	10.84**	44.10
Grapes	1,111.48	70.85	18.70**	17.42
Lemon	43.47	43.82	10.71**	24.42
Mango	2,63.83	40.10	8.40**	17.68
Oranges	102.30	118.73	17.98**	74.42
Pomegranate	307.21	73.46	19.15**	22.49
Watermelon	32.81	72.24	21.19**	20.46
Other Fresh Fruits	1,031.46	65.23	16.54**	10.84
Fresh Vegetables				
Green Chilli	138.16	75.24	20.70**	18.82
Garlic	54.35	77.26	17.61*	69.24
Onion	2,243.84	37.50	8.25**	21.67
Potato	303.50	82.76	21.56**	34.57
Tomato	290.40	80.19	14.85*	67.26
Other Fresh Vegetables	1,420.22	56.73	15.99**	24.05

Note: ***Significant at 1 per cent, **Significant at 5 per cent, *Significant at 10 per cent

per cent), other fresh fruits (16.54 per cent), other fresh vegetables (15.99 per cent), tomato (14.85 per cent) banana (10.84 per cent), lemon (10.71 per cent), mango (8.40 per cent) and onion (8.25 per cent) due to premium quality, hybrid varieties and organic varieties and reduction in tariff rates of fruits and vegetables.Instability indices for the export of fresh fruits and vegetables in terms of value showed that the oranges present the highest instability at 74.42 because of price fluctuations in global market and shifts in importer countries. Similar results were reported by Kamble *et al.*(2016) and Ramki *et al.*(2022).

Growth and instability for export of fruits and vegetables products in terms of quantity

The results for the compound annual growth rate and instability index for the export of fruits and vegetables products from India in termsof quantity for the period from 2006-07 to 2021-22 are presented in Table 3.

The compound growth rate for the export of fruits and vegetables products in terms of quantity showed a positive and significant growth rate for raisins (41.00 per cent), other vegetables products (betel leaves and nuts) (15.28 per cent), processed fruits, juices and nuts (10.15 per cent), onion (dried and powdered) (6.71 per cent) and processed vegetables (5.41 per cent), fruits and vegetables seeds (4.79 per cent), guar gum (4.73 per cent), mango pulp (3.63 per cent) and cucumber and gherkins (prepared and preserved) (1.03 per cent) which is mainly due to the improved transportation and logistics facilities for fruits and vegetables products exports. The scheme of Transport and Marketing Assistance (TMA) for marketing of Indian agriculture produce which includes fruits and vegetables products,other schemes like NCTF (National Committee on Trade Facilitation) and NTFAP (National Trade Facilitation Action Plan)had been formulated to improve road and rail connectivity to ports and smart gates at sea ports but walnuts showed negative and significant growth rate of -9.97 per cent due to competition from other countries.

Instability indices for the export of fruits and vegetables products in terms of quantity for potato (prepared and preserved) held the highest instability at 67.98 due to inadequate storage facilities,because of lack in development of scientific cold storage infrastructure facilities. Similar results were reported by Ramki *et al*. (2022).

Growth and instability for export of major fruits and vegetables products in terms of value

The results for the compound annual growth rate and instability index for the export of fruits and vegetables products from India in termsof value for the period from 2006-07 to 2021-22 are presented in Table 4.

The compound growth rate for the export of fruits and vegetables products in terms of value showed a positive and significant growth rate for raisins (50.48 per cent), potato (prepared and preserved) (40.64 per cent), other vegetables products (betel leaves and nuts) (23.09 per cent), processed fruits, juices and nuts (18.76 per cent), fruits and vegetables seeds (16.93 per cent), processed vegetables (14.04 per cent), onion (dried and powdered) (15.06 per cent), cucumber and gherkins (prepared and preserved) (8.71 per cent) and mango pulp (2.33 per cent) due to minimised interventions in domestic market and Export Promotion Capital Goods (EPCG) scheme being implemented to enable duty free exports for fruits and vegetables products but walnuts showed negative and

Table 3. Growth and instability for export of fruits and vegetables products in terms of quantity (2006-07 to 2021-22) (Quantity-Metric tonnes)

Particulars	Average	CV (%)	CAGR (%)	CDVI
Fruits Products				
Mango Pulp	1,42,267.01	21.15	3.63*	13.97
Processed Fruits, Juices and Nuts	22,0461.86	42.13	10.15**	12.42
Raisins	16,231.24	71.99	41.00**	46.58
Walnuts	4,482.06	49.80	-9.97**	28.87
Vegetables Products				
Cucumber and Gherkins (prepared and preserved)	2,25,812.84	13.92	1.03	13.42
Guar gum	3,90,991.83	43.79	4.73*	39.64
Onion (dried and powdered)	49,875.37	33.55	6.71**	19.93
Potato (prepared and preserved)	8,202.08	153.73	36.85	67.98
Other vegetables products (Betel Leaves and Nuts)	7,476.92	70.00	15.28**	40.45
Processed Vegetables	2,01,490.16	32.86	5.41**	16.71
Fruits and Vegetables Seeds	12,780.96	27.21	4.79*	17.90

Note: ***Significant at 1 per cent, **Significant at 5 per cent, *Significant at 10 per cent

Table 4. Growth and instability for export of major fruits and vegetables products in terms of value (2006- 07 to 2021 -22 (Value - ₹ in Crores)

Particulars	Average	CV (%)	CAGR (%)	CDVI
Fruits Products				
Mango Pulp	675.78	20.32	2.33*	18.44
Processed Fruits, Juices and Nuts	1,604.87	65.44	18.76**	15.92
Raisins	144.03	75.72	50.48**	46.34
Walnuts	140.06	53.59	-7.51**	44.33
Vegetables Products				
Cucumber and Gherkins (prepared and preserved)	918.20	40.33	8.71**	16.30
Guar gum	5,510.31	110.62	8.32	05.79
Onion (dried and powdered)	490.23	57.83	15.06**	18.63
Potato (prepared and preserved)	60.00	151.80	40.64**	57.63
Other vegetables products (Betel Leaves and Nuts)	80.04	85.15	23.09**	43.20
Processed Vegetables	1,609.54	58.01	14.04**	9.85
Fruits and Vegetables Seeds	398.98	65.44	16.93**	13.93

Note: ***Significant at 1 per cent, **Significant at 5 per cent, *Significant at 10 per cent

significant growth rate of -7.51 per cent due to shifts in consumer preferences and price fluctuations in international market.

Instability indices for the export of fruits and vegetables products in terms of value for guar gum held the highest instability at 105.79 due to market fluctuations in international market. Similar results were reported by Ramki *et al*. (2022).

Conclusion

The examination of export growth in major fresh fruits and vegetables from India indicates a clear upward trajectory. This positive trend is a result of heightened production levels of fruits and vegetables, showcasing a significant absolute growth rate. These findings suggest that India possesses the potential to further amplify its global market footprint, thereby fostering economic growth. Policies need to be focused to increase the exports of these crops. Scientific methods of cultivation of different crops and Sustainable agriculture need to be carried out to increase the productivity. Therefore, it is suggested that there is a need to develop efficient global value chains and encourage contract farming on a medium to long-term basis. Exporters and processors must be encouraged to buy directly from Farmer Producer Organizations (FPOs). Attention may be given to the diversification of fruits and vegetables exports and more destinations with improved infrastructure, trained human resources and support facilities to move up the value chain and meet international standards like sanitary and phytosanitary measures, etc. The efficiency at the production level needs to be raised in order to make the fruits and vegetables price competitive in the international market. The producers and exporters need to be educated and trained to maintain the quality of the fruits and vegetables as per global standards. There is a need to reduce the import of fruits and vegetables in order to get a favorable balance of payment. This will improve fruits and vegetables exports in the future in India. This expansion also holds the promise of advantageous outcomes for farmers and all involved in the agricultural value chain, while concurrently mitigating potential export risks in the times ahead.

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