An insight into the trend and instability of processed fruits export from India

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Abstract

India is one of the world's leading fruit and vegetable producers after China owing to its diverse agro-climatic conditions. However, the 20-30 percent of the produce is wasted because of its perishability. The processed form of fruits is the most convenient for storage and export owing to its demand in foreign countries. Hence, this study analyzed the growth and instability of different processed fruit exports in India from 2001-02 to 2022-23. The Compound Annual Growth rates showed that exports increased overall growth rate, with a higher growth rate for jam, jelly and marmalades at 12 percent, followed by dried fruits (9 percent) and mango pulp (0.08 percent) in quantity exported. The instability was calculated using the Cuddy-Della Index for processed fruits' export values (MT). It was realized from the result that the mango pulp category showed high instability in the overall export with Cuddy-Della Index value of 26.16 percent. In contrast, jam, jelly, marmalades, and dried fruits showed instability of 23.86 percent and 24.8 percent, respectively. This study concluded that proper infrastructure, cold chain, and supply chain for horticultural commodities should be developed for destination-specific production of processed fruits, as this could lead India to compete with global exporters and explore new alternate markets for the produce.

Key words: Cuddy-Della, concentration, instability, growth and trend

Introduction

India's standing as the world's second-largest producer of fruits, trailing only behind China, underscores its agricultural significance, facilitated by a diverse range of agro-climatic conditions. With an annual fruit production reaching 107.10 million metric tonnes in 2021-22, cultivated across 7.09 million hectares of land, India boasts a formidable presence in global fruit cultivation (Phadke *et al.*, 2022). Notably, the dominance of horticultural production has surged in recent years, surpassing agricultural production in 2015-16, with fruit crops accounting for 31.5 percent of horticulture crops, up from 29.5 percent in 2001-02.

India's prowess extends to producing specific fruits, where it assumes a leadership position globally. Notably, India is acclaimed as the world leader in the production of ginger, okra, banana, papaya, mango, and guava (Joshi *et al.*, 2019; Jaskani and Khan, 2021; Nuthalapati and Sharma, 2021). However, despite this agricultural abundance, a significant challenge persists in the form of postharvest losses, with approximately 40 percent of fruits and vegetables wasted annually due to inadequate infrastructure and poor postharvest management practices (CIPHET, 2015; Singh, 2009; Mohan *et al.*, 2023; Spiker *et al.*, 2023).

The processed fruit sector emerges as a strategic solution to mitigate losses and tap into international markets, driven by the inherent perishability of fresh fruits. With demand surging in foreign countries, processed fruits offer a convenient solution for storage and export, thereby presenting a lucrative opportunity for India's agricultural sector. This opportunity is further accentuated by recent trends indicating a robust 25 percent increase in the export of agricultural and processed food items during the first six months of the fiscal year 2022-23, compared to the same period in the previous fiscal year (Kumar, 2021).

The Directorate General of Commercial Intelligence and Statistics (DGCI&S) forecasts a 25 percent increase in the export of overall agricultural and processed food commodities, encompassing a diverse array of processed fruits and vegetables, from April to September 2022. This surge in demand underscores the immense potential for these commodities in international markets, where demand continues to escalate steadily.

Against this backdrop, this study endeavors to dissect the growth, trends, and inherent instabilities characterizing the export of processed fruits from India. By analyzing export data from 2001-02 to 2022-23, the research aims to comprehensively understand the export landscape, identify growth drivers, discern emerging trends, and assess vulnerabilities within specific product categories.

The research aims to analyze the historical growth patterns of various processed fruit categories in India's export market, identify emerging trends, and assess inherent instabilities using metrics like the Cuddy-Della Index. It seeks to explore factors driving growth and instability, including infrastructural constraints, market dynamics, and policy interventions. The ultimate goal is to provide actionable recommendations for policymakers, industry stakeholders, and exporters to enhance India's global processed fruit exports' competitiveness and sustainability.

Through this analysis, the study seeks to furnish actionable

insights for policymakers, industry stakeholders, and exporters to enhance India's competitiveness in the global processed fruit market while concurrently addressing food security concerns domestically.

Materials and methods

The data for this study were gathered from various secondary sources. Time-series data on processed fruit exports (in quantity and value terms) from India were gathered from the Agricultural and Processed Food Export Development Authority (APEDA) for 20 years from 2001 to 2023. The period was segregated into two periods to compare the trends and instability of processed fruits *viz.*, Period I from 2001-02 to 2010-11 and Period II from 2011-12 to 2020-23. The product-wise classification was adopted for Processed fruits such as mango pulp, squash, juices, jam, jelly and marmalades, dried fruits, berries, Preserved fruits and other processed fruits, where the most exported products were selected for further study, which in this case includes jam, jelly and marmalades, mango pulp and dried fruits.

Compound Growth Rate: CGR was calculated to identify the trend in producing and exporting processed fruits from India. The formula used in this study was similar to that described by Angles *et al.* (2011 in their study

$$Y_t = ab^t\, u_t$$

This analysis used annual time series data for the period 2001-2021 from various published sources like APEDA, UNCOMTRADE, and Horticultural Statistics Handbook for the export of various processed fruits from India in terms of quantity and value. The variables included in the formula are described as follows

where,

  Y = Export quantity (MT/yr) and value (US $)
  a = Intercept
  b = Regression coefficient
  t = Time variable (2001-2021)

The prescribed model was then transformed into logarithmic form, as given below, and used to estimate the co-efficient of selected variables in this study.

$$\ln Y_t = \ln a + t \ln b + \ln u_t$$

The regression analysis used the OLS method to work out the estimates. Then, the worked-out estimate (b) value for each

variable was used to calculate the compound annual growth rate (CAGR) using the following formula:

CAGR (r) = [Antilog (log b)$^{-1}$] × 100

where,

 r = Compound Growth Rate in percent

The t statistics were used to determine the standard error of growth rate and assess its significance.

 t = b_i/Se (b_i)

where,

 b_i = Regression coefficient

 Se = Standard error of the regression coefficient

Instability index: It is the measure used to assess the extent and degree of stability in exports and examine the risk associated with the profitability and export earnings of a particular commodity (Jayanti and Gopal, 2012). Coefficient of variation (CV) was used as straightforward measure for calculating instability, it has the disadvantage of overestimating the values when used for time-series data. Hence, the corrected CV was used in Cuddy-Della Valle Index, which de-trends the time series data and is accepted as the superior method to estimate instability (Vilhekar *et al.*, 2022). In this study, instability in production and export volumes was examined using the following model of the Cuddy-Della Valle index (CDVI):

$$CDVI^* = CV \times \sqrt{(1 - AdjR^2)}$$

CV is defined as the ratio of sample Standard Deviation (SD) to its mean, and $AdjR^2$ is the corrected coefficient of determination that fits the time series.

Result and discussion

Export of processed fruits from India: From the Fig.1, it is observed that the export of processed fruits from India increased from 431724.04 MT in 2012-13 to 3,79,607.31 MT in 2022-23. The major products for exporting processed fruits were jam, jelly and marmalades, mango pulp and dried fruits. Still, before 2016-17, mango pulp constituted 33 percent of the total processed fruits export, which declined to 28 percent in 2021-22 and the primary reason for this decline was the increased demand for jam, jelly and marmalades from the global market where it's percentage to the total processed fruits export increased from 32 percent in 2016-17 to 35 percent in 2021-22. The other reason for the decline in the export of mango pulp was the low yield of Totapuri and
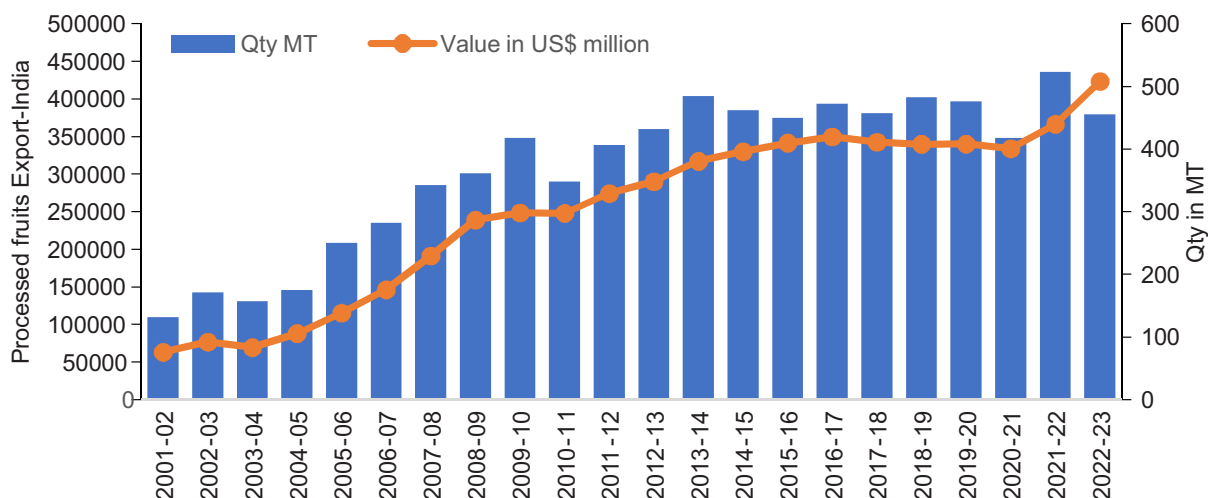

Fig. 1. Export of processed fruits from India (2001-02 to 2022-23). Source: APEDA

Alphonso varieties of mango, which is considered suitable for mango pulp production.

From the Fig.2, it was observed that the average export of total processed fruits was 230558.38 MT from 2001-02 to 2011-12, but it increased to 387226.28 MT in 2012-13 to 2022-23, a 59.54 percent increase from the previous 11-year average. This increase in the export of processed fruit was due to the increase in the capacity of production of fruit processing units from 10.30 lakh MT in 2001 to 23.08 lakh MT in 2021 (Goyal *et al.*, 2010; PIB, 2022), where the overall average export of processed fruits for 22 years from 2001 to 2023 was 308892.33 MT.
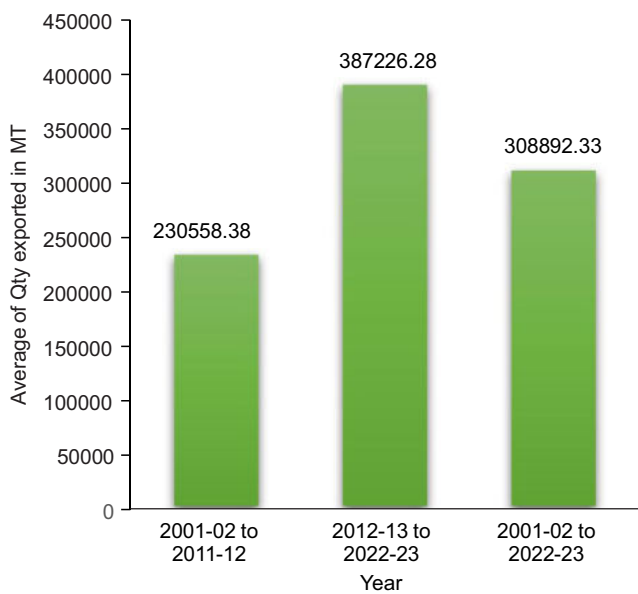

Fig. 2. Comparison of the average quantity of processed fruits exports

Export growth of processed fruits

Jam, jelly and marmalades: The growth performance of jam, jelly and marmalades export in volume and value was estimated at the national level. The results are presented in Table 1. The result of the analysis revealed that the jam, jelly and marmalades export in India had an increasing trend during period I (2001-2011) with a compound annual growth rate of 26.89 percent per annum, whereas the growth rate declined to 6.96 percent annum during period II (2011-2023).

Table 1. CGR of jam, jelly and marmalades exported from India

	Period	CGR	t-value
QTY (MT)	Period 1	26.89	10.22995
	Period 2	6.96	4.177665
	Overall	15.88	12.63898
Value (US$)	Period 1	31.52	11.16265
	Period 2	7.69	9.136261
	Overall	17.48	12.56952

It was noticed that the export quantity of jam, jelly and marmalades decreased due to lower prices and demand in the international market, unfavorable currency movements and international developments like sanctions against Iran and Russia. It was observed from Fig. 3 that there is a drastic increase in the export of Jam, Jelly and Marmalades from 8346 MT (2001-02) to 1,44,584.21 MT (2022-23) where the export peaked during

2018-19 with 1,76,118 MT and 1,81,412.07 MT (2021-22) of jam, jelly and marmalades exported from India.

Mango pulp: The growth performance of mango pulp export in terms of volume and value was estimated at the national level, and the results are presented in Table 2. The result of the analysis revealed that the mango pulp export in India was increasing trend during period I (2001-2011) with the compound annual growth rate of 8.77 percent per annum, whereas a negative rate of 4.69 percent per annum was observed during period II (2012-2023). It was noticed that decreasing in the export quantity of mango pulp in the second period was due to the shift in the demand from mango pulp to the jam, jelly and marmalades of mango. As 75 percent of the pulp in India is made of the Totapuri variety, Alphonso and other varieties account for 20 and 5 percent of the total mango pulp produced in the country. According to market estimates, the production of Totapuri mangoes fell by 50 percent during 2021 from an average of 2 million tonnes.

Table 2. CGR of mango pulp export from India

	Period	CGR	t-value
QTY (MT)	Period 1	8.77	5.550247
	Period 2	-4.69	-3.46897
	Overall	0.01	0.008601
Value (US$)	Period 1	13.85	7.413482
	Period 2	-0.75	-0.42702
	Overall	2.56	2.368108

Consequently, the price of the fruit (pulp variety, not table variety) has also gone from Rs 8 per kg last year to over Rs 10 per kg. The decline in the export of mango pulp was the decline in export to Egypt as they have started growing their varieties and also captured our share of export to the Middle-East countries. India faces higher competition from Africa, where the multinational company Del Monte established its pulp production and exported it to various countries. The average orchards in South America and Africa are high thus enable them to supply in bulk as well as in cheaper prices compared to us thus captured our share in target countries. In contrast, they prioritize exporting to EU without any duty, but India has to bear 3.8 percent duty for pulp and 6 percent duty for concentrates while exporting to EU. It was observed from Fig. 4 that there is a declining trend in the export of mango pulp from India from 2001-02 to 2022-23 where the export peaked during 2009-10 with 1,86,198 MT of mango pulp exported from India.

Dried fruits: The growth performance of dried fruit export in terms of volume and value was estimated at the national level, and the results are presented in Table 3.

Table 3. Compound annual growth of dried fruits export from India

	Period	CGR	t-value
QTY (MT)	Period 1	21.13	14.31913
	Period 2	3.98	1.620675
	Overall	10.66	9.324823
Value (US$)	Period 1	34.82	15.42787
	Period 2	2.66	1.521987
	Overall	17.63	9.911653

The analysis revealed that the dried fruit export in India increased during period I (2001-2011) with a compound annual growth rate
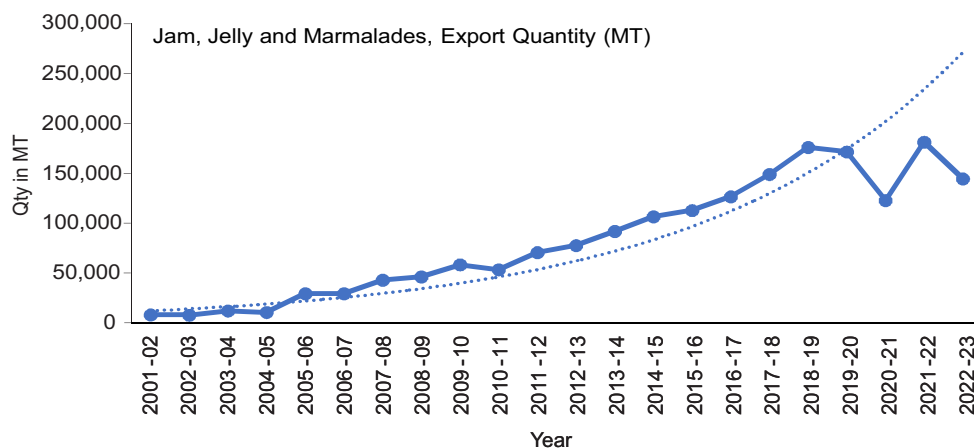
Fig. 3. Trend in export of jam, jelly and marmalades from India. Source: APEDA, Export Statistics
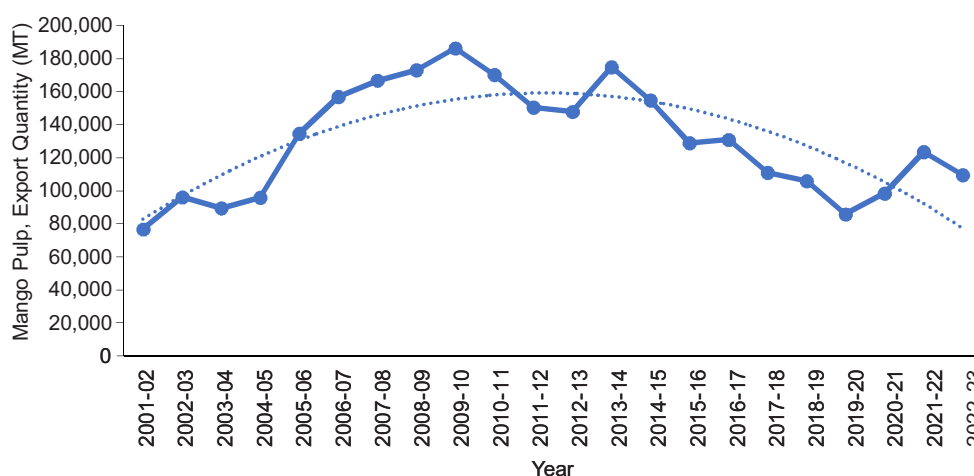

Fig. 4. Trend in the export of mango pulp (in MT) from India. Source: APEDA, Export Statistics

residue of pesticides, which reduced the export share of raisins from 40 percent (2009-10) to 17 percent (2010-11). In 2016, India placed 9th in the export of raisins, with 35,756 MT of exports and a trade value of US$ 44,514. Still, in 2021, the export declined to 20,783 MT and India went to 14th position in the export of raisins, where countries like Greece, Uzbekistan, UAE, EU, Germany and the Netherlands captured the world exports. From Fig. 5, it was observed that the overall export of dried fruits increased from 5,640 MT in 2001-02 to 76,354.73 MT in 2022-23, but there observed an all-time decrease in exports in the year 2014-15, which was due to a decline in the production and export share of dried prunes from 13 percent in 2013-14 to 3 percent in 2014-15 and also due to decline in raisins exports.

Instability of jam, jelly and marmalades export from India: Table. 4 indicates the instability of jam, jelly and marmalades exports in terms of quantity and value from India. It was observed that the instability was higher in the first period, with CDVI at 33.36 percent in terms of

of 21.13 percent per annum, whereas the growth rate declined to 3.98 percent per annum during period II (2012-2023). It was noticed that the decrease in the export quantity of dried fruits was due to the emergence of more competitors around the world for raisins, as this was the major product, with 40 percent of the total dried fruit exports from India. The other reason for this decline was the decline in the export of tamarind, which accounted for 30 percent of the total dried fruits exports that was due to the drop in the price of the tamarind by 30 percent following higher production and lack of export order (Subramani, 2012). From the Fig. 5, it was observed that there was a shrink in the export of dried fruits during 2010-11, which was mainly due to the export ban of Indian grapes in the EU countries because of the exceeded
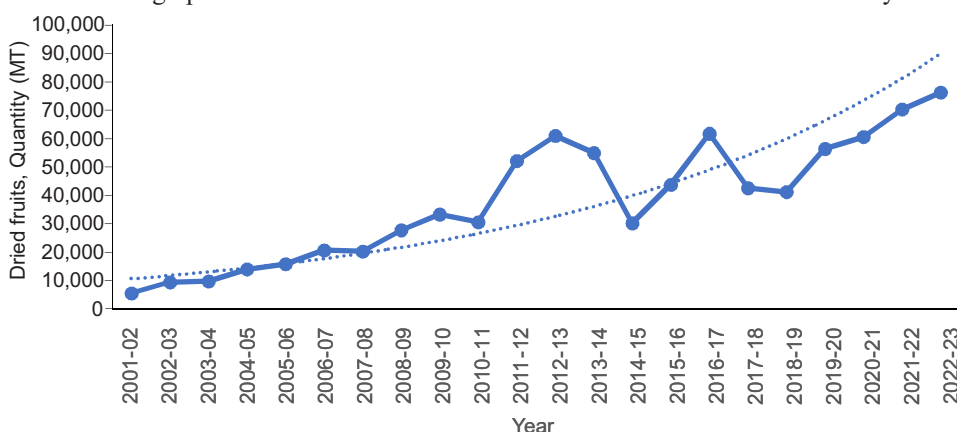
quantity. In contrast, it decreased to 16.06 percent in period II, with the overall instability at 23.86 percent. There observed a higher difference between the instability between period I and period II in terms of quantity and value of exports due to higher instability in the exchange rate as well as the unit price realised in the world market. The steady growth rate in the export of jam, jelly and marmalades stabilized the export, which was indicated by the decreasing instability in period II.

Instability of mango pulp export from India: The instability in the export of mango pulp in terms of quantity and value was estimated and given in Table 5. There was a huge difference in the instability between Period I and Period II and the overall instability in the export of mango pulp was 26.16 percent, which was due to the decreasing export of mango pulp in period II from 1,47,815.69 MT in 2012-13 to 1,09,501.38 MT in 2022-23.

Instability of dried fruits exported from India: Table 6 indicates the estimated instability index for the export of dried fruits in terms of volume and values from India. The estimated instability values showed that the index was higher in period II, with 23.34 percent, than in period I, with 20.02 percent. This was due to the unstable growth trend in period II but the

Fig. 5. Trend in the export of dried fruits (in MT) from India

growth was stable for period I as shown in Fig. 5. But it was contrast for the value terms where period I has higher instability than period II which was due to the higher difference in the unit price realised in period I. The minimum and maximum unit price for dried fruits ranged from US$ 318 to US$ 1033 in period I, but in period II it was stabilized with the minimum unit price of US$ 1008 to a maximum unit price of US$ 1630.

This study has analysed the growth trend in the export of processed fruits in terms of value and volume and the instability in their export. The major processed fruits exported were analysed for growth rate and instability in which the CAGR was higher for jam, jelly and marmalades, which was due to the demand pattern shift at the global level and shift in the export of Indian processed fruits from mango pulp to highly demanded jam, jelly and marmalades. A study conducted by APEDA in 2015 also showed similar results of increasing trend in the export of jam, jelly and marmalades with 22 percent CAGR during 2009-14 period with 5 percent of global share but with the existence of 50 percent gap in the unit price realised for Indian products during that period. The mango pulp export showed negative growth rate in period II, which was due to the increased domestic demand from 2009-10 to 2018-19, which reduced the export (Rabha

and Sarma, 2021) even though there is increased production of mango was from 16196400 MT in 2011-12 to 20386000 MT in 2020-21. The major contributors in the dried fruit export from India are raisins, tamarind and prunes. Afghanistan is the leading exporter of dried fruits in the world, but in 2021, the Taliban attack collapsed the Afghanistan market creating an opportunity for Indian dried fruit export to capture the unexplored markets. The reason for the increase in dried fruit exports was the increasing demand for Indian tamarind in global markets (FIEO, 2020). But the export of these products is not exploited to its maximum and the reason is a lack of infrastructure, *viz.*, vapour heat treatment in the secondary processed products like mango pulp (APEDA, 2015), whereas the low-cost technology in competitive countries, *viz.*, Thailand, Mexico and Netherlands captured the Indian mango pulp market. Hence, infrastructure development for low-cost processing is needed to compete with the global exporters. Encouraging fruit production and processing diversification aims to prevent the overproduction of any single commodity. This strategy also promotes geographic diversification, which helps mitigate trade disruption risks caused by trade conflicts or political and economic instability in specific countries. Proper production technology and destination-specific packing and labelling knowledge for the processors should be disseminated through proper channels to increase exports and retain global markets.

The study on processed fruit exports from India spanning from 2001-02 to 2022-23 reveals significant insights into the growth trends and instability within various product categories. Compound Annual Growth Rates (CAGR) indicate an overall increasing trend in exports, particularly notable in jam, jelly, and marmalades, while mango pulp and dried fruits exhibit varying growth patterns. Instability, as measured by the Cuddy-Della Index, underscores the need for targeted interventions to stabilize export trajectories. Despite India's strong position as a leading fruit producer, challenges such as postharvest losses persist, emphasizing the imperative for enhanced infrastructure and supply chain management. Addressing these challenges could bolster India's competitiveness in the global processed fruit market, tapping into emerging opportunities while mitigating risks associated with market fluctuations and demand dynamics.

Table 4. Instability of jam, jelly and marmalades export from India

Period	Qty (in MT)				
	Mean	SD	CV	Adj R^2	CDVI
Ist (2001-2011)	33771.93	37982.38	112.47	0.91	33.36
IInd (2011-2021)	132917.14	34712.87	26.12	0.62	16.06
Overall	83344.54	58173.17	69.80	0.88	23.86
	Value (in USD)				
Period	Mean	SD	CV	Adj R^2	CDVI
Ist (2001-2011)	35698842.11	51299598.27	143.70	0.93	39.31
IInd (2011-2021)	145916873.64	36673114.39	25.13	0.89	8.26
Overall	90807857.87	64561082.88	71.10	0.88	24.42

Table 5. Instability of mango pulp export from India

Period	Qty (in MT)				
	Mean	SD	CV	Adj R^2	CDVI
Ist (2001-2012)	136025.64	68462.22	50.33	0.75	25.23
IInd (2013-2023)	124647.1918	26461.778	21.23	0.52	14.64
Overall	130336.4159	33273.92	26.25	-0.05	26.16
	Value (in USD)				
Period	Mean	SD	CV	Adj R^2	CDVI
Ist (2001-2012)	107919257.3	62339201	57.76	0.84	22.84
IInd (2013-2023)	115635703	19875818	17.19	-0.09	17.94
Overall	111777480.2	35289700	31.57	0.18	28.59

Table 6. Instability of dried fruits export from India

Period	Qty (in MT)				
	Mean	SD	CV	Adj R^2	CDVI
Ist (2001-2012)	21847.44	20237.19	92.63	0.95	20.02
IInd (2013-2023)	54549.46	13725.8	25.16	0.14	23.34
Overall	38198.45	21375.44	55.96	0.8	24.8
	Value (in USD)				
Period	Mean	SD	CV	Adj R^2	CDVI
Ist (2001-2012)	15854708	20402880	128.69	0.96	25.89
IInd (2013-2023)	62024363	10416814	16.79	0.12	15.79
Overall	38939535	26819253	68.87	0.82	29.03

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Reference

Angles, S., A. Sundar and M. Chinnadurai, 2011. Impact of globalization on production and export of turmeric in India–An economic analysis. *Agric. Econ. Res. Rev.,* 24(2): 301-308.

Goyal, S.K. and R.B. Gupta, 2009. Fresh and Processed Fruit and Vegetables: Growth in Production and Export from India. *Foreign Trade Rev.*, 43(4): 32-51.

Hasija, R.C., L.S. Kaushik, K.S. Suhag and D.R. Aneja, 2004. Growth and trend in area, production and productivity of wheat in Haryana. *Agric. Sci. Dig.,* 24(2): 91-94.

Jaskani, M.J. and I.A. Khan, 2017. Horticulture: An Overview. p. 7. In: Horticulture Science and Technology. University of Agriculture, Faisalabad. Khan, A. S. and K. Ziaf. ISBN 978-969-8237-93-6.

Jeyanthi, P. and N. Gopal, 2012. Growth and instability in Indian frozen scampi export. *Fishery Tech.,* 49: 187-192.

Joshi, P., U. Kulkarni, S. Munje and S. Kulkarni, 2019. Impact of Covid-19 pandemic on Indian fruits and vegetables export, postharvest management supply chain and future strategies. *Agric. Int.*, 6(2): 4-8.

Kumar, V. 2021. Trends and performance of India's Agricultural Trade in the midst of COVID-19 pandemic. *Indian J. Agric. Econ.*, 76(3): 352-370.

Nuthalapati, C.S. and R. Sharma, 2021. Requirement and Availability of Cold-Chain for Fruits and Vegetables in the Country. *Benefits*, 23: 4.

Parihar, S. 2015. Investigating growth, instability and concentration of Indian agricultural export. *Ind. Mgmt. J.*, 13-19.

Phadke, M., B. Karandikar and A. Gulati, 2022. Grapes and pomegranate value chains. Agricultural Value Chains in India: Ensuring Competitiveness, Inclusiveness, Sustainability, Scalability, and Improved Finance, *Springer*, 145-193 Singapore. https://doi.org/10.1007/978-981-33-4268-2_5

Rabha, L. and R.K. Sarma, 2021. Growth and export potential of horticultural crops from India: An overview. *Econ. Aff.,* 66(2): 253-258.

Singh, H.P. 2009. Triggering agricultural development through horticultural crops. *Indian J. Agric. Econ.*, *64*(1).

Spiker, M.L., J. Welling, D. Hertenstein, S. Mishra, K. Mishra, K.M. Hurley, R.A. Neff, J. Fanzo and B.Y. Lee, 2023. When increasing vegetable production may worsen food availability gaps: A simulation model in India. *Food Policy*, 116: 102416. ISSN 0306-9192, https://doi.org/10.1016/j.foodpol.2023.102416.

Subramani, M.R. 2012. Lack of export orders squeezes tamarind prices. February 22, 2012. https://www.thehindubusinessline.com/markets/commodities/lack-of-export-orders-squeezes-tamarind-prices/article23071675.ece

Vilhekar, R.A., V.G. Pokharkar and D.B. Yadav, 2022. Growth and instability of area, production and productivity of acid lime in India and Maharashtra. *J. Pharm. Innov.,* 11(6): 589-593.