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Growth and instability index of export of processed vegetables from India

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Abstract
The present study aimed to analyze the growth and instability index of processed vegetables from India. The study depends on secondary data which was collected from Agricultural and Processed Food Export Development Authority for the year 2012-13 to 2021-22 (April-January). The compound annual growth rate analysis and Cuddy Della Valle Instability Index and Markov chain analysis was employed for analysis of growth rate and instability index of processed vegetables exported from India. The result reveals that growth rate of quantity and value of export of processed vegetables from India showed positive growth of 8.87 per cent and 10.11 per cent respectively with significant at 1 per cent. The instability indices for export of processed vegetables from India is positive in both quantity (0.18) and value (0.08) and lies in the range between 0 and 15 which infers low instability.

Keywords: Compound annual growth rate, processed vegetables, instability index

Introduction

Horticulture crops in India are currently grown in 27.59 million hectares with the production of estimate of horticulture crop production is a record 331.05 million tonnes in 2020-21 (Source: https://www.outlookindia.com/website/story/business-news-india-expects-record-horticulture-crops-production/399220), an increase of 10.6 million tonnes or 3.3 per cent rise over the previous year. The fruits production in 2020-21 is 103 million tonnes as against 102.1 million tonnes in the previous year, while vegetable production has risen from 188.3 million tonnes to 197.2 million tonnes. Among vegetable crops, onion production is rised from 26.1 million tonnes to 26.8 million tonnes, while potato production is a record 54.2 million tonnes, 5.6 million tonnes higher than in the previous year. Similarly, in the case of tomatoes, India has experienced 21.1 million tonnes production as compared to 20.6 million tonnes in the previous year.

India is the largest horticulture crop producer in the world, however, due to inadequate infrastructure and just 10 per cent being channelled into food processing, over 30 per cent of produce gets damaged. The government through some new initiatives is striving to reduce this loss by promoting and incentivizing food processing and improved storage infrastructure.

India's vast vegetable production provides tremendous export prospects. India exported vegetables worth ₹ 4,969.73 crores in 2020-21. Vegetable post-harvest losses are expected to be between 5 and 10 per cent and horticulture losses are projected to be around 16 per cent. India wastes more fruits and vegetables than consumed in United Kingdom (UK). The fruits and vegetables will deteriorate during storage through loss of moisture, loss of stored energy (e.g. carbohydrates), loss of other foods (e.g. vitamins), physical loss through pest and disease attack, loss due to physiological disorders, fiber development, greening, root growth, shoot growth, seed germination etc… processing is one of the best method to reduce the losses. Processing includes canning, drying of foods (dehydration), packed vegetables, primary and secondary processed vegetables, preparation of pickles, chutneys, sauces, sauer kraut, etc… These are the processed products are in greater demand in international market.

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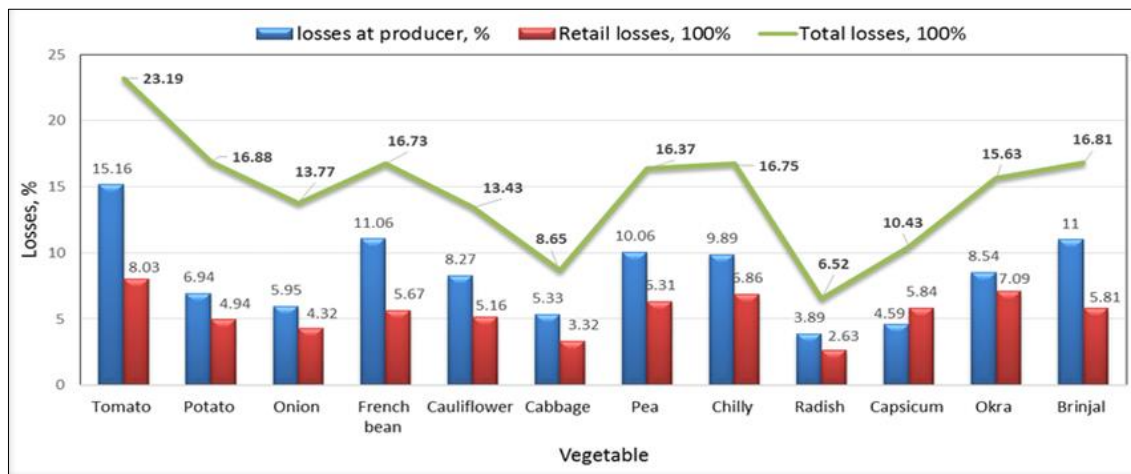
Fig 1: The above figure showing the post-harvest losses of vegetables at producer level as well as retailer level

The above figure showing the post-harvest losses of vegetables at producer level as well as retailer level. To overcome these losses the better option is vegetable processing or manufacture of processed vegetables. These processed vegetables are in greater demand in abroad, making efficient use of this can earn revenue.

Methodology
The research was based on secondary data obtained from the APEDA database. Time series data on the export of processed vegetables from India from 2012-13 to 2021-22 (April-January). The export of processed vegetables from India was studied using the compound annual growth rate, co-efficient of variation and instability index.

Compound Annual Growth Rate Analysis
The compound annual growth rate of processed vegetable exports from India is also calculated using an exponential function of the form.

$$Y_t = A \ B_t \ u_t \tag{1}$$

Where

Y_t = export of processed vegetables from India

t = Year 1, 2, ……, n

u_t = disturbance term for the year 't'

The equation (1) was transformed into a log linear form and written as

$$\text{Log } Y_t = \text{Log } A + t \log B + \log u_t \tag{2}$$

Compound Annual Growth Rate was calculated as g^ = (b-1)*100

Where
g^ = Estimated Compound Annual Growth Rate (%)
b = Antilog of B

Cuddy Della Valle Instability Index
Cuddy and Valle (1978) created the Cuddy- Della Valle index to measure the instability in time series data that is characterised by trend. The co-efficient of variation was calculated using the expression to investigate the stability of processed vegetable exports. The Cuddy Della Valle Index is used to measure the instability in this study. The Cuddy Della Valle index de-trends the given series first, indicating the direction of instability. The use of the coefficient of variation as a measure of instability in time series data has significant drawbacks. If the time series data show any trend, the variation assessed by coefficient of variation can be overstated, i.e., if coefficient of variation is used to quantify instability, the region with expanding output at a constant rate will score high in instability. In contrast, the Cuddy-Della Valle index uses coefficient of determination to de-trend the coefficient of variation.

The coefficient of variation (CV) is a statistical measure of data points' dispersion around the mean in a data series. The coefficient of variation is a useful statistic for assessing the degree of variation between two data series, even if the means are radically different. It indicates the ratio of the standard deviation to the mean.

$$\text{Coefficient of variation} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

The co-efficient of variation (%) was calculated to determine the extent of fluctuation in processed vegetable exports in terms of quantity and value over time. The instability index was also calculated to look at the volatility of processed vegetable exports from the country in terms of quantity and value over time using the following formula:

$$\text{Instability Index (I)} = CV * \sqrt{1 - Adj \ R^2}$$

Where
CV = Coefficient of Variation
Adj R^2 = Coefficient of determination
The ranges of CDVI (Sihmar, 2014) are given as follows:
Low instability = between 0 and 15
Medium instability = greater than 15 and lower than 30
High instability = greater than 30

Results and Discussion
Growth and instability index of export of processed vegetables from India
The table 1 presents the growth and instability index of export of processed vegetables from India. The export data taken for the period of ten years from 2012-13 to 2021-22 (April-

January). The results reveal that over the period of ten years the quantity of export of the processed vegetables experienced positive growth rate i. e. Compound Annual Growth Rate (CAGR) of 8.87 per cent in the same way the value in terms of Rs. Crore also experienced same as the quantity of export i. e. positive Compound Annual Growth Rate (CAGR) of 10.11 per cent.

The Cuddy-Della Valle Index (CDVI) also analyzed to know the instability index and it is also presented in the table 1. The result reveals that the CDVI of the quantity and value is 0.18 and 0.08 respectively, which shows that as low instability in terms of both quantity and value over the period of ten years.

Table 1: Growth and instability index of export of processed vegetables from India

Sl. No.	Year	Quantity (Qtl)	Value (₹ in Crore)
1	2012-13	1930991.48	1357.58
2	2013-14	2046626.22	1707.39
3	2014-15	1803884.70	1913.40
4	2015-16	1773325.17	1994.56
5	2016-17	2105824.14	2280.04
6	2017-18	2264839.04	2211.59
7	2018-19	2481223.27	2474.00
8	2019-20	2532769.74	2760.53
9	2020-21	4033553.79	3718.63
10	2021-22 (April-January)	3975467.37	3301.35
	CAGR (%)	8.87**	10.11**
	Mean	2494850.49	2371.91
	Standard Deviation	835502.44	722.36
	Coefficient of variation	0.33	0.30
	Adjusted R^2	0.72	0.92
	CDVI	0.18	0.08

Source: APEDA
Note: CAGR: Compound Annual Growth Rate, CDVI: Cuddy Della Valle Index, Qtl: Quintal, ** Significant at 1 percentage
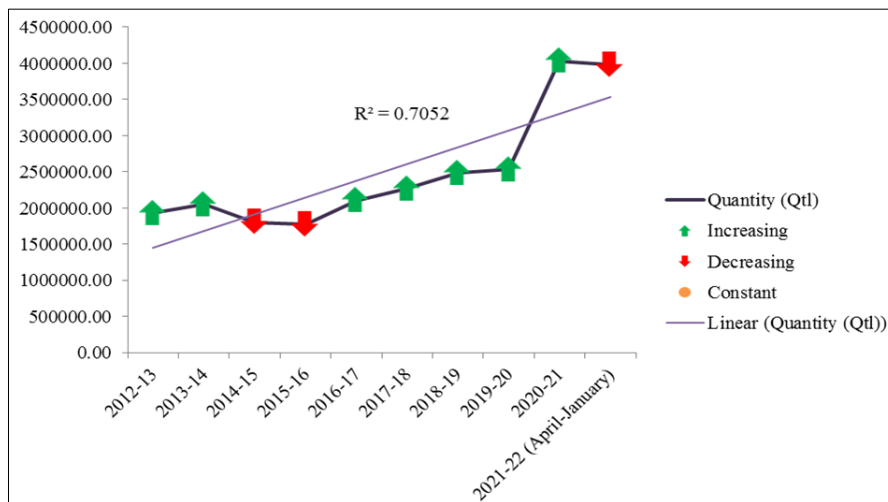

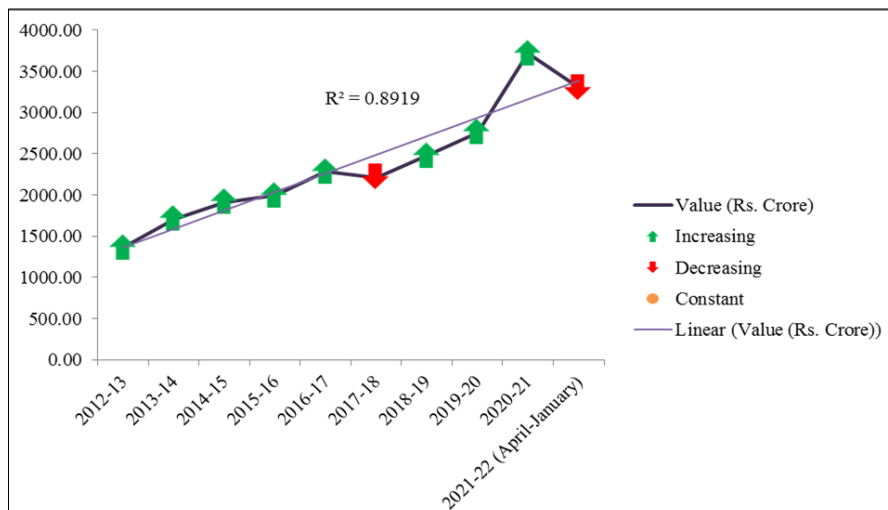**Fig 1:** Trends in growth of export of processed vegetables from India in quantity

Fig 2: Trends in growth of export of processed vegetables from India in value

Conclusion

This study has analyzed the growth trend in export of processed vegetables from India and the instability by Cuddy Della Valle Index. The growth rate of quantity and value of export of processed vegetables from India showed positive growth trend with significant at 1 per cent. The instability indices for export of processed vegetables from India is positive in both quantity and value and lies in the range between 0 and 15 which indicates less risk in export of processed vegetables from India in future.

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