



Structural changes in India's trade of grapes: A markov approach

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Abstract

To access the growth and structural changes taking place in grapes area, production, productivity and trade aspects, and this analysis was carried out for a period of 25 years ranging from 1994-95 to 2019-20. It was done by calculating compound and simple growth statistics and by developing separate transitional matrix for exports and imports. Results regarding area, production, productivity, export quantity and value of exports was calculated. The analysis was attempted through linear programming method to access the transition probabilities for the major grapes export markets of Indian grapes and nations importing grapes to India. It revealed that Germany though with low retention probability, was the most stable export destination of Indian grapes. To the flipside, Netherland, UK, Bangladesh, UAE, Hong Kong, Thailand and Nepal were seen to be the most unstable markets. In conclusion, the growth in production (5.84%) of the world's largest producer was far behind the simultaneous growth in import quantity (%).

The top 5 countries consuming Indian grapes were Netherland, UK, Russia, Bangladesh and Germany. These countries also shows highest growth rates in terms of value which shows more earnings to India for less quantity. It shows positive future for Indian grapes exports. None of the countries depicted negative growth rates in terms of quantity as well as export value for grapes export from India. It shows the export potential at higher growth rate for export of grapes to these 10 major importing countries from India with highest earnings to the Indian farmers.

Keywords: exports, trade, transition matrix, structural changes, area, production, productivity

Introduction

Grape (*Vitis vinifera*) is an important fruit crop in India. Grape is the third most widely cultivated fruit after citrus and banana. The total world production of grapes is estimated to be about 68.9 million tonnes, next only to citrus and bananas and is followed by apples. Grape scientifically is called *Vitis vinifera* L. and is also known as 'queen of fruits'. The country has the distinction of achieving the highest productivity of grapes among the 90 grape growing countries in the world, with an average yield of 30 t/ha. Cultivation of grapes in the country is very much localized, being confined primarily to four states, viz., Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu, which together account for more than 90 percent of the area and production.

The grape is cultivated in the largest area i.e. 139 thousand ha and the production is around 2920 thousand tons in India in 2017-18(NHB). Major grape-growing states in India are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Punjab, Haryana, western Uttar Pradesh, Rajasthan and Madhya Pradesh. In India mainly Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu jointly contribute to more than 90 per cent of the total area and production of grapes.

India is the agriculture country. Near about 65% of the total population of India is depend on agriculture and 52% of the total working force in India is working in Agriculture Sector. In India, 36% of the total population of India is under BPL & maximum % is from farmers. Maximum agricultural commodities are perishable or semi-perishable i.e. mainly fruits and vegetables. Outcome from agriculture sector is very less.

India is the largest country in Food grains production. It ranks first in the world with annual production 203.00 Million Tonnes in the year 2019-20. India ranks second in the fruits and vegetables production. The annual fruits production in India is 95.00 Million Tonnes and vegetables production is 181.00 Million Tonnes. India was the largest country in the milk production with 165.00 Million Tonnes in the year 2017-18.

Objectives

1. To study the export potential for grapes and its processed products.

Methodology

Trends in Quantity and Value of Grapes Export

The time series data on quantity and value of grapes export will compiled from the authentic source viz; from various Government departments, institutes, online portals and from various Government publications.

Compound Growth Rates (CGR)

The compound growth rate analysis will be worked out to ascertain the growth in quantity and value of grapes export from India and Maharashtra by fitting an exponential function as given below,

$$Y_t = ab^t u$$

Where,

Y = Quantity and value of grapes export from Maharashtra and India

a = Intercept
 b = Regression coefficient
 t = Time period (years)
 u = Error term with zero mean and constant variance
 Logarithmic transformation of provided estimating equation is,

$$\ln(Y_t) = \ln(a) + t \ln(b) + \ln(u)$$

The equation is estimated by ordinary least square technique (OLS). From the coefficient values, the Compound Growth Rate (CGR) was then estimated using the formula,

$$CGR(r) = [\text{Antilog}(b) - 1] \times 100$$

Where,
 r = Compound growth rate in percent
 The 't' test will be used to test the significance.

Estimation of Variability of Quantity and Value of Grapes Export

The variability in export quantity and values of grapes will be worked out by estimating the values of coefficient of variation. The coefficient of variation in export quantity and values of grapes will be worked out by using following formula,

$$C.V. (\%) = [SD / (\Sigma X / n)] \times 100$$

Where,
 C.V. = Coefficient of variation
 S.D. = Standard deviation
 X = Grapes export quantity and values
 n = No. of years

Results and Discussion

The process of export would play an important role in Indian economy by earning foreign income to the farmer which is the gain to India. The import of grapes from other countries shows the opportunities to increase the production of grapes in India. Therefore, the study was under taken to see the growth rates and coefficient of variation for export quantity and value of grapes from India to various countries. Also the study was conducted for growth rates and coefficient of variation for import of grapes to India from various countries. The annual export and import data was used to analyse the growth rates and year to year variation using exponential trend function. This data was used analyse direction of trade and changing pattern of Indian grape export using Markov chain analysis. Markov chain analysis was employed to analyse the structural changes in any system whose progress through time can be measured in

terms of single outcome variable. In the present study, the dynamic nature of trade pattern i.e. the gains in export of grapes in major importing countries and losses in import of grapes from major exporting countries was examined using Markov chain model. It shows the transitional probability of exports or imports switching from one country to other. It also measures the probability of an exporting country retaining its market share in the importing nation.

Growth Performance of various Aspects of Grapes in India

The grapes segments growth was analysed using compound growth rates and results have been presented in the following Table.

Table 1: Compound Growth Rates regarding different aspects of grapes from India, 1994-95 to 2018-19

Particulars	CGR(% Per annum)
Area	6.48***
Production	5.84***
Productivity	- 0.61 ^{NS}
Export Quantity	13.19***
Export Value	20.01***

***, ** and * represent Significance at 1 percent, 5 percent and 10 percent

Upward growth rate was found for area (6.48), production (5.84), productivity (-0.61), export quantity (13.19) and value of export (20.01) at 1 percent level of significance. The growth rate for productivity of grapes shows decreasing rate of -0.61 percent which is not significant due to continuous change of climate which effects on the yield of grapes. The compound growth rate for export quantity and export value were 13.19 and 20.01 percent respectively at 1 percent level of significance. The growth rates for export value of grapes are found significantly higher than the export quantity which was beneficial to India to earn more earnings to the farmers. Both the growth rates indicates that the export quantity and export value of grapes increases at higher rate for the period of 25 years. The growth rates in quantity and value of grapes export showed a positive future for Indian grapes exports while the international trade growth indicator export indicate higher percentage for export quantity and value.

Changing Demand in Major Export Destinations

The top countries consuming Indian grapes exports were identified. These were Netherland, UK, Russia, Bangladesh, Germany, UAE, Saudi Arab, Hong Kong, Thailand and Nepal. The annual growth rates of quantity and value of exports during 1994-95 to 2018-19 of these nations individually have been presented in the following table.

Table 2: Destination-wise growth rates in export of grapes from India, 1994-95 to 2018-19

Sr. No.	Country	Export Quantity			Export Value		
		CGR (%)	CV (%)	R ²	CGR (%)	CV (%)	R ²
1	Netherland	21.67***	101.81	0.87***	29.15***	126.92	0.93***
2	UK	4.19***	40.20	0.52***	11.12***	84.33	0.88***
3	Russia	20.69**	46.87	0.56**	25.34**	52.04	0.66**
4	Bangladesh	13.87***	99.74	0.36***	20.40***	132.76	0.58***
5	Germany	19.09***	151.78	0.71***	26.40***	193.91	0.83***
6	UAE	6.86***	47.04	0.81***	12.47***	80.71	0.95***
7	Saudi Arab	16.35***	105.05	0.69***	23.92***	132.06	0.85***
8	Hong Kong	17.02***	136.37	0.56***	26.95***	163.20	0.63***

9	Thailand	27.97***	87.89	0.73***	51.10***	109.85	0.81***
10	Nepal	11.80***	53.06	0.60***	22.71***	80.43	0.83***
	Others	14.04***	97.38	0.89***	22.85***	133.61	0.94***
	India	13.19***	81.96	0.87***	20.01***	121.00	0.96***

***, ** and * represent Significance at 1 percent, 5 percent and 10 percent

The growth rates for export values shows increasing trend at very high level for all 10 major countries for 25 years period. The growth rates of export value for Netherland (29.15%), UK (11.12%), Russia (25.34%), Bangladesh (20.40%), Germany (26.40%), UAE (12.47%), Saudi Arab (23.92%), Hong Kong (26.95%), Thailand (51.10%) and Nepal (20.01%) was shows highly significant. It shows the top countries consuming Indian grapes were identified. The top 5 countries consuming Indian grapes were Netherland, UK, Russia, Bangladesh and Germany. These countries also shows highest growth rates in terms of value which shows more earnings to India for less quantity. It shows positive future for Indian grapes exports. None of the countries

depicted negative growth rates in terms of quantity as well as export value for grapes export from India. It shows the export potential at higher growth rate for export of grapes to these 10 major importing countries from India with highest earnings to the Indian farmers.

Transitional Probability Matrix for Grapes Export to 10 Major Countries from India

Below given the table for transitional probability matrix showing for grapes export quantity from India to major countries, which gives countries loosing, gaining and retaining Indian grapes market share.

Table 3: Transitional probability matrix for grapes export quantity from India (1994-95 to 2018-19)

	Netherland	UK	Russia	Bangladesh	Germany	UAE	Saudi Arab	Hong Kong	Thailand	Nepal	Other Countries
Netherland	0.580448	0	0.021405	0.127029	0.018345	0	0.024871	0	0.012241	0.074297	0.141365
UK	0	0.788849	0	0	0	0.159288	0.00531	0	0	0	0.046553
Russia	0.203101	0	0.721083	0	0.037244	0	0	0.008717	0.029854	0	0
Bangladesh	0.189476	0.01264	0	0.669278	0	0.065435	0.026424	0	0.007284	0.029463	0
Germany	0	0	0	0.988762	0.011238	0	0	0	0	0	0
UAE	0	0.126586	0	0.020223	0	0.580704	0	0	0	0	0.272486
Saudi Arab	0	0	0	0	0	0	0.582674	0.159951	0	0	0.257374
Hong Kong	0.345513	0.53385	0	0	0	0	0.120637	0	0	0	0
Thailand	0	0	0.374826	0	0	0	0	0	0.625174	0	0
Nepal	0	0	0.030885	0.969115	0	0	0	0	0	0	0
Other Countries	0.578966	0	0	0.000891	0.186079	0	0	0.028521	0	0.055419	0.150124

The retention probability matrix was developed using Markov chain analysis for the top-most nations where Indian grapes are consumed through imports. The results are presented in Table 3. It revealed that Germany though with low retention probability, was the most stable export destination of Indian grapes. To the flipside, Netherland, UK, Bangladesh, UAE, Hong Kong, Thailand and Nepal were seen to be the most unstable markets. Thailand and Nepal had probably lost its complete share to the countries categorized as ‘others’.

Conclusions

When the parameters indicating domestic and international trade scenario were calculated for grapes in India, the parameters such as area, production, productivity, export quantity and value of exports all showed upward growth over the study period for last 25 years by analysing the export statistics of grapes from India, major customers came out to be its neighbours such as Bangladesh, Nepal and others customers are Netherland, UK, Russia, Germany, UAE, Saudi Arab, Hong Kong and Thailand. The export market was seen barely improving over the past situation. India has earned a unique distinction of being the largest exporter of grapes. This tag has always brought a huge balance of trade deficit along with it.

It revealed that Germany though with low retention probability, was the most stable export destination of Indian grapes. To the flipside, Netherland, UK, Bangladesh, UAE, Hong Kong, Thailand and Nepal were seen to be the most unstable markets.

It is also evident that, as there is comparatively marginal increase in area, production and productivity, a lot of efforts

is needed to be invested in improving grapes production and productivity so as to earn more benefits to Indian farmers i.e. feeding the growing domestic demand, keeping its prices low along with increasing farmer’s income.

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