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Stability analysis of Indian grapes exports

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Abstract

Grape (*Vitis vinifera*) is one of the most delicious refreshing and nourishing fruits. It is universally consumed as table fruit and ripen grapes are easily digestible. The study was based on the time series, secondary data collected from different reliable resources and data were collected for the period of 2007-08 to 2019-20. The area of grapes in the year 2007-08 was 68 thousand hectares has rose to 140 thousand hectares in the year 2019-20. Production which was 1735 thousand Mt in the year 2007-08 was increased to 3125 thousand Mt in the year 2019-20. Five major countries which are importing grapes from India are Netherland, Russia, United Kingdom, Bangladesh and Germany. Russia, United Kingdom, Bangladesh and Germany were found to be stable markets with good amount of retention of market share. The country Netherland retained 36 per cent of its previous market share of which it lost to Russia with 9 per cent, 3 per cent to Germany and 51 per cent to other minor importing countries during the study period. Russia and Germany were found to be more stable market in terms of value for the grapes that are exported during the study period. Netherland, United Kingdom, Bangladesh and other minor importing countries were found to be moderately stable. Government need to meet the demands as per the specifications of the country to retain the country to be loyal for the imports of grapes.

Keywords: trend, markov chain analysis, export, structural composition

Introduction

Grape is a fruiting berry of the deciduous woody vines of the botanical genus *Vitis vinifera*. Grapes can be eaten raw or they can be used for making wine, jam, juice, jelly, grape seed extract, raisins, vinegar and grape seed oil. Grapes are a non-climacteric type of fruit, generally occurring in clusters. Grape (*Vitis vinifera*) is one of the most delicious refreshing and nourishing fruits. It is universally consumed as table fruit and ripen grapes are easily digestible. They are rich in energy giving sugars and some useful minerals like phosphorus, iron and vitamins like B1 and B2. Majority of grapes produced in the world is pressed for wine making (80%), nearly 10 per cent for raisin making, hardly 5 per cent is used as table grapes and remaining 5 per cent is used as unfermented beverage. Grapes are also processed into products like raisins, juice and jellies. Grape juice is a refreshing drink, a stimulant to kidneys and also as a laxative.

The major producers of grapes are China, Italy, USA, Spain, France, Turkey, Chile, Argentina, Iran and India. The major exporters are Chile, USA, Turkey, South Africa, Italy, Mexico Spain, Peru, Brazil and Greece. The major export markets for Indian grapes are Bangladesh (35.42%), Netherlands (21.5%), and U.K. (13.85%), U.A.E. (10.87%), Germany (3.01%) and others (15.35%). These five countries accounted for 84.65 per cent of the India's fresh grapes export. India stood at 15th place and contributes 1.46 per cent in world's fresh grapes export. An attempt has been made to quantify the changing structure of Indian grapes exports.

Major grape-growing states are Maharashtra, Karnataka, Telangana, Andhra Pradesh, Tamil Nadu, and the north-western region covering Punjab, Haryana, western Uttar Pradesh, Rajasthan and Madhya Pradesh total area of different states in grape 1237.80 thousand hectare and production 24272.53 metric tonnes in the year 2017-18. Maharashtra ranks first in terms of production accounting for more than 81.22 per cent of total production and highest productivity in the country. More than 20 varieties are under cultivation in India. However, only a dozen are commercially grown. Maharashtra ranks first in terms of production accounting for more than 81.22 per cent of total production and highest productivity in the country. Major Export Destinations (2019-20): Netherland, Russia, U K, Bangladesh Pr, Germany.

Grape is one of the important fruit covering an area of 123 thousand hectares occupying 2.01 per cent of the total area. The country is also a major exporter of fresh Grapes to the world. The country has exported 1, 93,690.55 MT of Grapes to the world for the worth of Rs.2,

176.88 crores/ 298.05 USD Millions during the year 2019-20. The total production of grapes in the world in the 2019-20 is 77.10 million metric tons. But in case of India total area of grape 1488 thousand hectare and production of grape 30308 thousand metric tonnes.

Methodology

Growth rate analysis

The growth rate of area, production, productivity and export of mango was computed for a period from 2007-08 to 2019-20. The liner, log liner, exponential and power function are some of the important functional form employed to study the growth rate.

Deferent functional form was tried past for working out of growth rates in area, production, productivity and export. Some of the important forms tried were the linear growth model ($y = a + bt$), exponential function ($y = ab^t$) and quardic function ($y = a + bt + ct^2$) however, it was found the exponential form of the function $y_t = ab^t$ is better and most frequently used one. In the present study, compound growth rate for study, compound growth rate for area, production, productivity and export of grapes were estimated by using exponential growth function (Angles 2001) of the form

$$Y_t = ab^t + U_t \dots \dots (1)$$

Where,

Y_t = Dependent variable for wich growth rate was estimated (area, production, yield, quantity and unit value cashew export in year "t")

a= Intercept

b= Regression co-efficient

t= year which value from 1, 2, ..., n

U_t = disturbance term in year "t"

The equation one is transform into log-linear and written as

$$\log y_t = \log a + t \log b + \log U_t \dots \dots (2)$$

Equation (2) was estimated by using ordinary least square (OLS) technique. The per cent compound growth rate (g) was derived using the relationship (3)

$$g = (\text{anti log} - 1) \times 100 \dots \dots (3)$$

Where,

g= estimate compound growth rate per annum in percentage.

b= antilog of log b

Tabular presentation technique

Tabular analysis was adopted to study the structural composition of exports of fruits from India. For this analysis, the country wise export data of quantity and value of grapes, were selected and arranged in a systematic manner to describe the structural composition of exports.

Pattern of foreign trade

Markov chain first order process to study the direction of Indian grapes exports. The structural change in exports was examined using the Markov Chain Approach.

Central to Markov Chain Analysis is the estimation of the Transitional Probability Matrix P. The element P_{ij} of this matrix indicates the probability that exports will switch from

country i to country j with the passage of time. The diagonal P_{ij} measures the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports.

$$E_{jt} = \sum_{i=1}^r E_{ij} - P_{ij} + e_{jt}$$

Where,

E_{jt} = Exports from India during the year t to j^{th} country.

E_{it-1} = exports to i^{th} country during the year t-1.

P_{ij} = The probability that exports will shift from i^{th} country to j^{th} country.

e_{jt} = The error term this is statistically independent of E_{it-1}

r = the number of importing countries

The Transitional Probability P_{ij} , which can be arranged in a (c x r) matrix, have the following properties.

$$0 \leq P_{ij} \leq 1$$

$$\sum_{i=1}^r P_{ij} = 1 \text{ for all } j$$

Thus, the export proportions of each country during period t were obtained by multiplying the exports to these countries in the previous period (t-1) with the Transition Probability Matrix.

The Transitional Probability Matrix is estimated in the Linear Programming (LP) frame work by a method referred to as Minimization of Mean Absolute Deviation (MAD).

The LP formulation is stated as

$$\min OP * + Ie$$

Subject to –

$$XP * + V = Y$$

$$GP * = 1$$

$$P * \geq 0$$

Where,

P^* is a vector in which probability P_{ij} are arranged,

0 is a vector of zeros,

I is an appropriately dimensioned vector of area,

e is the vector of absolute errors (IUI)

Y is a block diagonal matrix of lagged values of Y and

V is the vector of errors

G is a grouping matrix to add the row-elements of p arranged in P^* to unity.

Results and Discussion

Trend in area, production and productivity of grapes

The table 1 presents the trend in area, production and productivity of grapes in India. The area of grapes in the year 2007-08 was 68 thousand hectares has rose to 140 thousand hectares in the year 2019-20. Average area during the study period is 114 thousand hectares with coefficient of variation to be 20.61 per cent. The growth rate of area was found to be 5.05 per cent with the statistical significance at 1 per cent probability level. The coefficient of determination registered at 70 per cent. The next variable that is production which was 1735 thousand Mt in the year 2007-08 was increased to 3125

thousand Mt in the year 2019-20. Average production during the study period was around 2331 thousand Mt having the growth rate of 7.85 per cent with the time variable of 59 per cent. The overall analysis of growth rate was found to be statistically significant at 1 per cent probability level. The last variable that is yield, in the year 2007-08 yield was 25.51 Mt/ha was having the variation in the study period. The average yield was registered at 21 MT/ha with the growth rate of 2.66 per cent during the study period. The coefficient of determination accounted to 83 per cent respectively. Area

under grapes is increasing in the major parts of the southern states of the country. Since grape is such kind of a fruit which is used for multipurpose that is in preparation of juice, raisin and red wine. As there is huge demand in the domestic and international market for the grapes. Coefficient of variation was not much indicating that there is not much change in the area to other crops. The growth rate in production signified that grapes are produced widely across the nation to meet the demands at national as well as international level (Lathika and Ajithkumar 2005) [9].

Table 1: Trend in area, production and productivity of grapes in India

Years	Area (000 ha)	Production (000 Mt)	Yield (Mt/ha)
2007-08	68	1735	25.51
2008-09	80	1878	23.48
2009-10	106	881	18.28
2010-11	111	1235	15.13
2011-12	116	2221	19.15
2012-13	118	2483	21.04
2013-14	88	2454	27.89
2014-15	123	2823	22.95
2015-16	122	2590	21.23
2016-17	137	2922	21.33
2017-18	139	2920	21.01
2018-19	140	3041	21.72
2019-20	140	3125	22.32
Total	1488	30308	267
Mean	114	2331	21
Std	23.60	710.35	5.32
CV	20.61	30.47	25.92
CAGR (%)	5.05**	7.85**	2.66
R ²	0.70	0.59	0.83

** Significant at 1 percentage

* Significant at 5 percentage

The Table 2 depicts the trend in production under grapes of different states. Production in Andhra Pradesh was 2.80 thousand MT in the year 2007-08 which was increased to 15.92 thousand MT in 2017-18. Average production in grapes was around 22.62 thousand MT during the study period. Negative growth rate was registered with 1.82 per cent with the R² value of 85 per cent. In Karnataka the production was found to be 258.8 thousand MT in the year 2007-08 which rose to 524.2 thousand MT in 2017-18. The average production during the study period was found to be 355.7 thousand MT with the growth rate of 6.60 per cent while coefficient determination to be 81 per cent. The production in Maharashtra state was found to be 1290 thousand MT in the year 2007-08 increased to 2286.44 thousand MT in 2017-18. There was a positive growth rate with 11.43 per cent having the time variable with 61 per cent, an average production during the study period registered with 1722.2 thousand MT. For Mizoram state the production of grapes was 8.3 thousand MT in the year 2007-08 was increased to 18.0 thousand MT in 2017-18 with a growth rate of 7.45 per cent which was explained by the time variable with 95 per cent. An average production during the study period was around 18.41 thousand MT. In case of Punjab state, the production of grapes in the year was found to be 21.0 thousand MT which

was decreased to 8.23 thousand MT in 2017-18 having a negative growth rate of 9.60 per cent which was explained by the time variable of 84 per cent. For the state of Tamil Nadu in the year 2007-08 the production was around 83.5 thousand MT which was decreased to 58.93 thousand MT in 2017-18. There was a negative growth rate in production with the value of 7.19 per cent which was explained by the time variable of 46 per cent. The other states producing grapes had the growth rate of production in grapes of 4.93 per cent with the time variable explaining to the tune of 93 per cent respectively. Among the selected states that is Andhra Pradesh, Karnataka, Maharashtra, Mizoram, Punjab and Tamil Nadu. The states which exhibited a negative growth rate are Andhra Pradesh, Punjab and Tamil Nadu the reason for decline in area can be endorsed for the decline in production in these states. The maximum growth rate was observed in Maharashtra state as this state is one of the major states for growing the grapes. In March 2020, a new variety has been released that is ARI-516 which is a multi-purpose grape variety with a musky flavour and is moderately resistant fungal diseases developed by Agricultural Research Institute (ARI) of Pune. Introduction of new high yielding variety has boosted for the increase in area of the crop (Chadha 2006) [3].

Table 2: Trend in production under grapes of different states (MT/hectare)

Years	Andhra Pradesh	Karnataka	Maharashtra	Mizoram	Punjab	Tamil Nadu	Others
2007-08	2.80	258.80	1290.00	8.30	21.00	83.50	66.80
2008-09	62.20	269.00	1415.00	10.00	22.10	91.00	2.50
2009-10	29.80	317.60	440.00	13.70	15.50	44.10	7.50
2010-11	27.60	330.30	774.00	20.40	12.50	53.00	17.10
2011-12	28.90	288.10	1810.00	24.30	12.50	55.10	2.00
2012-13	31.50	320.90	2050.00	20.80	12.50	43.40	2.00
2013-14	8.90	302.40	2160.00	23.90	12.00	47.30	28.80
2014-15	11.20	420.80	2292.50	22.60	9.20	32.60	30.90
2015-16	14.64	429.78	2048.11	22.55	8.49	34.10	30.17
2016-17	15.36	450.79	2378.17	18.00	8.22	29.02	20.86
2017-18	15.92	524.20	2286.44	18.00	8.23	58.93	7.09
Total	248.82	3912.67	18944.22	202.55	142.24	572.05	215.72
Mean	22.62	355.70	1722.20	18.41	12.93	52.00	19.61
SD	16.23	86.48	656.60	5.52	4.85	19.89	19.43
CAGR (%)	-1.82	6.60**	11.43*	7.45*	-9.60**	-7.19*	4.93
R ²	0.85	0.81	0.61	0.95	0.84	0.46	0.93

** Significant at 1 percentage

* Significant at 5 percentage

Structural composition of exports

Percentage share to total export of grapes from India is depicted in table 3. Five major countries which are importing grapes from India are Netherland, Russia, United Kingdom, Bangladesh and Germany. In the year 2008-09, among total exports Netherland share was 20.60 per cent, Russia share was 0.58 per cent, United Kingdom 10.73 per cent, Bangladesh 46.03 per cent and Germany to be 1.07 per cent. The other importing countries had the share of 20.99 per cent. In the year 2019-20 the share of Netherland among the total exports was 29.05 percent, Russia 12.25 per cent, United

Kingdom 7.48 per cent, Bangladesh 16.90 per cent and Germany to be 4.50 per cent. The other minor importing countries had the share of 29.81 per cent. The other minor importing countries had also a major share indicating that there is a huge demand for India grapes in the International market. As per APEDA report on the country Netherlands, the country imports Indian Grapes and markets the grapes to the European countries. Thomson seedless variety is the major variety that is having huge demand in the International market (Aneja 2017) [2].

Table 3: Percentage share to total export of grapes from India

Years	Netherland	Russia	U K	Bangladesh	Germany	Others
2008-09	20.60	0.58	10.73	46.03	1.07	20.99
2009-10	24.56	0.64	12.19	37.86	1.37	23.38
2010-11	19.67	2.20	7.48	41.17	0.70	28.78
2011-12	19.38	4.86	6.92	37.57	0.63	30.64
2012-13	25.48	11.27	10.52	23.10	1.04	28.60
2013-14	28.76	14.52	10.42	19.41	1.51	25.38
2014-15	34.78	13.08	13.98	3.68	2.71	31.77
2015-16	37.99	9.38	13.27	5.90	3.18	30.28
2016-17	27.72	11.26	6.84	19.20	5.27	29.71
2017-18	31.06	14.58	9.88	2.70	8.74	33.05
2018-19	29.36	12.31	7.15	18.86	6.39	25.93
2019-20	29.05	12.25	7.48	16.90	4.50	29.81

To examine the direction of trade

Table 4 presents the transitional probability matrix of Indian grape exports from 2008-09 to 2019-20. Russia, United Kingdom, Bangladesh and Germany were found to be stable markets with good amount of retention of market share. While Netherland and others minor importing countries had retained a moderate market share. The country Netherland retained 36 per cent of its previous market share of which it lost to Russia with 9 per cent, 3 per cent to Germany and 51 per cent to other minor importing countries during the study period. It gained the market share from Russia to the extent of 36 per cent, 1 per cent from Bangladesh and 52 per cent from other minor importing countries. Russia retained a share of 60 per cent of its previous market share with the gain in its market share from Netherland, Germany and other minor importing countries to the tune of 9 per cent, 8 per cent and 5 per cent respectively. During the study period Russia lost its market

share to Netherland and Germany to the extent of 36 per cent and 3 per cent. The next country which was found to be stable was United Kingdom which retained a share of 64 per cent of its previous market share. The retention of the previous market share was from Bangladesh and Other minor importing countries to the tune of 8 per cent and 5 per cent. Country Bangladesh retained the share of 69 per cent from its previous market share and found to be stable market. It lost its market share to Netherland, United Kingdom and other minor importing countries to the tune of 1 per cent, 8 per cent and 20 per cent. Germany was found to be stable market with the retention of the share with 54 per cent of its market share which it was gained from Netherland and Russia with 3 per cent each. It lost its market share to 8 per cent to Russia, 20 per cent to Bangladesh and 16 per cent to other minor importing countries. The other countries retained the share of 36 per cent of its previous market share losing to Netherland

52 per cent, Russia and United Kingdom 5 per cent each. It gained the share from Netherland, Bangladesh and Germany to the tune of 50 per cent, 20 per cent and 16 per cent respectively. While Netherland and others minor importing countries had retained a moderate market share. The country Netherland retained 36 per cent of its previous market share of which it lost to Russia with 9 per cent, 3 per cent to Germany and 51 per cent to other minor importing countries during the study period. As it is evident from the table Bangladesh was the most stable market which was followed by United Kingdom, Russia, Germany, other minor importing countries and Netherland for Indian grapes that is exported. Even though there is imposition of import duties, Bangladesh retained the market share and was found to be the most stable nation for the Indian grapes respectively (Sadavatti, 2006) [11]. Transitional probability matrix of India grape exports in terms of value for the period of 2008-09 to 2019-20 is presented in Table 5. Russia and Germany were found to be more stable market in terms of value for the grapes that are exported during the study period. Netherland, United Kingdom, Bangladesh and other minor importing countries were found to be moderately stable. Netherland retained the share of 46 per cent of its previous year. It lost its share to Germany and other minor importing countries with 1 per cent and 51 per cent respectively. On the other side the share was gained from Russia, United Kingdom, Bangladesh and Other minor importing countries to the extent of 39 per cent, 33 per cent, 15 per cent and 31 per cent respectively. Russia retained the share of 51 per cent to its previous market share of which it lost its remaining market share to Netherland 39 per cent and

Germany with 8 per cent. Russia had gained the share from Germany and Other importing states to extent of 17 per cent and 14 per cent. United Kingdom retained 36 per cent of its previous market share, as it lost the share to Netherland at 33 per cent and Bangladesh 29 per cent. The next country which was listed in the table was Bangladesh which retained a share of 27 per cent as it lost 15 per cent of its share to Netherland, 19 per cent to United Kingdom and 38 per cent to other minor importing countries. At the same time, it had gained its market share from Netherland and Russia with a major of 1 and 8 per cent. The other minor importing countries which were grouped under others retained the market share of 30 per cent of its previous market share. It lost its market share Netherland with 31 per cent, Russia to be 14 per cent and United Kingdom to be 23 per cent respectively. Russia and Germany were found to be more stable market in terms of value for the grapes that are exported during the study period. Netherland, United Kingdom, Bangladesh and other minor importing countries were found to be moderately stable. Netherland retained the share of 46 per cent of its previous year. It lost its share to Germany and other minor importing countries with 1 per cent and 51 per cent respectively. As it is evident from the table all the countries were found to be stable as there was some level of retention of the share with its previous year. The most stable market that was observed was Germany, followed by Russia, Netherland, United Kingdom, other minor importing countries and Bangladesh. Government need to meet the demands as per the specifications of the country to retain the country to be loyal for the imports of grapes Satishkumar *et al.* 2016) [12].

Table 4: Transitional probability matrix of Indian grapes exports (quantity) from 2008-09 to 2019-20

Country	Netherland	Russia	U K	Bangladesh	Germany	Others
Netherland	0.3609	0.0955	0.0000	0.0000	0.0372	0.5064
Russia	0.3630	0.6063	0.0000	0.0000	0.0308	0.0000
U K	0.0064	0.0000	0.6419	0.3517	0.0000	0.0000
Bangladesh	0.0134	0.0000	0.0898	0.6942	0.0000	0.2026
Germany	0.0000	0.0865	0.0000	0.2024	0.5476	0.1635
Others	0.5279	0.0551	0.0557	0.0000	0.0000	0.3613

Table 5: Transitional probability matrix of Indian grapes exports (value) from 2008-09 to 2019-20

Country	Netherland	Russia	UK	Bangladesh	Germany	Others
Netherland	0.4691	0.0000	0.0000	0.0000	0.0166	0.5143
Russia	0.3945	0.5171	0.0000	0.0000	0.0884	0.0000
U K	0.3393	0.0000	0.3620	0.2987	0.0000	0.0000
Bangladesh	0.1529	0.0000	0.1920	0.2715	0.0000	0.3835
Germany	0.0000	0.1739	0.0000	0.1645	0.6094	0.0523
Others	0.3117	0.1467	0.2371	0.0000	0.0000	0.3046

Conclusion

Horticulture is an inevitable segment playing a major role in the economy of Indian agriculture. The area of grapes in the year 2007-08 was 68 thousand hectares has rose to 140 thousand hectares in the year 2019-20. Production which was 1735 thousand Mt in the year 2007-08 was increased to 3125 thousand Mt in the year 2019-20. Five major countries which are importing grapes from India are Netherland, Russia, United Kingdom, Bangladesh and Germany. Russia, United Kingdom, Bangladesh and Germany were found to be stable markets with good amount of retention of market share. The country Netherland retained 36 per cent of its previous market share of which it lost to Russia with 9 per cent, 3 per cent to Germany and 51 per cent to other minor importing countries during the study period. Russia and Germany were found to

be more stable market in terms of value for the grapes that are exported during the study period. Netherland, United Kingdom, Bangladesh and other minor importing countries were found to be moderately stable. Government need to meet the demands as per the specifications of the country to retain the country to be loyal for the imports of grapes.

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