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Export profile and trade direction of fresh grapes from India: Markov chain approach

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Abstract

The paper explores the direction of trade and changes in the export of fresh grapes from India. The secondary data on the quantity of fresh grapes exported to various countries were collected for 1999-00 to 2018-19, and the data were analyzed using Markov Chain analysis. The study is divided into Period-I (1999-00 to 2008-09) and Period-II (2009-10 to 2018-19). During the 20 years of the study Period, India has exported 1960180.67 tonnes of fresh grapes worth 2358.02 million dollars or 1379520.12 lakh rupees. The findings of the study reveal that during the Period I, Bangladesh UK were highly stable markets, UAE, Netherlands, Saudi Arabia were moderately stable markets, and Russia was a less stable market for fresh grapes export of India. On the other hand, Germany, Nepal, Thailand and other countries were the most unstable importers of Indian fresh grapes. During the study Period-II, Germany, Bangladesh, Netherlands and 'other countries' were stable markets for fresh grapes export from India. In contrast, Nepal, Russia, Saudi Arabia, Thailand, UK and UAE were the unstable importers of Indian fresh grapes.

Keywords: Direction of trade, Markov chain, fresh grapes, stable market, unstable market

Introduction

Grapes are a kind of fruit that grows in clusters. It is known as 'Queen of Fruits' and has various colours like crimson, black, dark blue, yellow, green, orange and pink with varieties of taste and flavour. The scientific name of the grape is *Vitis vinifera*, which belongs to the family Vitaceae; it is a non-climacteric fruit that grows on the perennial and deciduous woody climbing vine. It is a cross-pollinated vine with simple, lobed, cut or toothed leaves (rarely compound), racemes of greenish flowers, and seeded or seedless fruit made up of watery or fleshy pulp, stones, and skin. Grapes can be eaten raw or used to make jam, juice, jelly, vinegar, wine, grapes seed extracts and grapes seed oil. In its natural habitat, grapes bear fruit during the hot and dry season and go dormant during the severe cold. It can withstand frost during the resting stage but is extremely vulnerable during the growing stage. Temperatures between 15 °C to 35 °C are suitable for shoot growth and normal physiological processes of grapevine. When the temperature drops below 10 °C, vines are unable to grow and bear fruit. Grapes grow best in areas where the annual rainfall is less than 900 mm.

The Middle East is known as the homeland of grapes, and its cultivation started there between 6000 to 8000 years ago. Grape culture (or viticulture) dates back to the dawn of civilization. Archaeological evidences indicate that humans started growing grapes as early as 6500 B.C during the Neolithic period. Grape cultivation is one of India's most profitable farming ventures. The medicinal properties of grapes were described by famous Indian medicine scholars Sasruta and Charaka in their medical treatises titled 'Sasruta Samhita' and 'Charaka Samhita' respectively, written between 1356 BC to 1220 BC. Kautilya described the type of land suitable for grape cultivation in his 'Arthashastra', written in the fourth century BC. Cultivated grapes are believed to have been introduced in the North part of India by the Persian invaders in 1300 AD, from where they were introduced it to the South (Daulatabad in Aurangabad district of Maharashtra). Grape was also introduced in the south in Salem and Madurai districts of Tamil Nadu by the Christian missionaries around 1832 AD and Hyderabad province by HEH, the Nizam of Hyderabad in the early part of the 20th century. According to Shikhamany, (2001) ^[10] from Delhi, Daulatabad, Madurai, Salem and Hyderabad, grape cultivation spread throughout the country.

Grapes occupy a dominant position in global fruit production. In 2019, grapes ranked 5th among fruit crops, trailing only bananas, watermelons, apples and oranges in terms of production (statista.com).

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The total global grapes production (2019) was approximately 77.14 million tonnes with productivity of 11.14 tonnes/ha (FAOSTAT). Grapes have taken a prominent place in the export market among fruit crops. India ranked 9th in the world in terms of export quantity and 11th in terms of export value in 2019 (FAOSTAT). In 2018-19, total grapes production of India was 3.041 million tonnes from an area of 140 thousand hectares with productivity of 22 tonnes per hectare (indiastat.com). Maharashtra is the leading state in terms of both area and production and the state accounts for about 78 percent production of the country. During the 2018-19 fiscal year, India exported 0.246 million tonnes of fresh grapes worth 334.79 million dollars. The major export destination for Indian fresh grapes during 2018-19 was Netherlands (72262.13 tonnes), followed by Bangladesh (46419.00 tonnes), Russia (30293.17 tonnes), U.K (17596.82 tonnes), Germany (15739.17 tonnes), UAE (12772.08 tonnes), Saudi Arabia (9203.74 tonnes), Nepal (5974.26 tonnes), Oman 4338.30 tonnes), Hong Kong (4038.56 tonnes) (APEDA). As we know that grapes has spread over the globe due to its important characteristics so there is need to test its feasibility in export and trade in international market. The present study aimed to throws a light on export performance and trade analysis along with projection of fresh grapes export in India.

Methodology

The trade directions of export for 1999-00 to 2018-19 and the forecast quantity of fresh grapes export for 2019-20 to 2021-22 from India were estimated using the Markov-chain model. For this purpose, the study Period was divided into two Periods (Period-I: 1999-00 to 2008-09 and Period-II: 2009-10 to 2018-19), and the secondary data were collected from the APEDA website. The transitional probability matrix was obtained for Period-I and II using the proportion of the actual export to different importing countries. The major importing countries considered for the trade analysis in Indian fresh grapes were the Netherlands, Bangladesh, the United Kingdom (UK), the United Arab Emirates (UAE), Russia, Germany, Saudi Arabia, Nepal and Thailand. All other remaining Indian fresh grapes importing countries were grouped under the 'other countries' category. The matrix gives a broad indication of the direction of trade of Indian fresh grapes export. The row elements in the transitional probability matrix provide the information of the extent of loss in trade on account of competing countries. The column element indicates the probability of gains in trade volume from other competing countries, and the diagonal element indicates the probability of retaining the previous year's trade volume by the respective country.

Markov chain analysis is the estimation of the transitional probability matrix P_{ij} . The elements P_{ij} of the matrix P indicate the probability that export will switch from i th country to j th country with time (Dent, 1967) [1]. The diagonal elements of the matrix measure the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the preference of an importing country to a particular country's exports. In the current application context, structural changes were treated as a random process with selected importing countries. The average exports to a particular country were considered to be a random variable that depends only on the past exports to that country, which can be denoted algebraically as

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

Where,

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

E_{it-1} = Exports from India to the i^{th} country during the Period $t-1$.

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

e_{jt} = the error term which is statistically independent of E_{it-1} .

t = Number of years considered for the analysis

r = Number of importing countries

The transitional probabilities P_{ij} which can be arranged in a $(c \times r)$ matrix, have the following properties.

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

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

Thus, the expected export shares of each country during Period " t " were obtained by multiplying the export to these countries in the previous Period ($t-1$) with the transitional probability matrix.

Estimation of the P_{ij}

In the present study, the Minimum Absolute Deviations (MAD) estimation procedure was employed to estimate the transitional probability, which minimizes the sum of absolute deviations (Fisher, 1967; Wagner, 1959) [3, 13]. The conventional linear programming technique was used, as this satisfies the properties of transitional probabilities of non-negativity restrictions and row sum constraints in estimation.

The linear programming formulation is stated as

$$\text{Min } OP^* + Ie$$

Subject to,

$$XP^* + V = Y$$

$$GP^* = 1$$

$$P^*e \geq 0$$

Where,

0 = vector of zeroes.

P^* = vector in which probability P_{ij} are arranged.

I = appropriate dimensioned column vector of units.

e = vector of absolute error ($|U|$).

Y = vector of export to each country.

X = block diagonal matrix of lagged values of Y

V = vector of errors

G = grouping matrix to add the row elements of P as arranged in P^* to unity.

After calculating the transitional probability matrix, the expected shares of export were calculated by

$$Y_{jt} = \sum_{j=1}^r Y_{i(t-1)} \times (j=1,2,3\dots r)$$

Where,

Y_{jt} = Predicted proportions of j^{th} country's share at time ' t '.

Y_{t-1} = Observed proportion of j^{th} country share at time ' $t-1$ '.

P_{ij} = Estimated transitional probability matrix.

Kiran and Sivakumar (2016), Nithin (2016) adopted the same methodology to determine the export direction of fresh grapes from India.

Results and Discussion

Export profile of Indian Fresh Grapes

India is a major producer and exporter of fresh grapes. It plays a significant role in the global fresh grapes market. Fresh grapes are exported to more than 50 nations throughout the world. The export profile of the top ten fresh grapes importing countries from India based on the average quantity of fresh grapes imported for the last 20 years, from 1999-00 to 2018-19, is discussed here.

India has exported 1960180.67 tonnes of fresh grapes with an average of 98009.03 tonnes per year in the 20 years of the study Period. Out of the total quantity, the highest (26.45 percent) of fresh grapes was exported to the Netherlands, followed by Bangladesh (22.17 percent), the United Kingdom (11.78 percent), the United Arab Emirates (9.35 percent), Russia (7.89 percent), Germany (3.77 percent), Saudi Arabia (3.48 percent), Nepal (3.28 percent), Thailand (1.54 percent), Belgium (1.31 percent) and other countries (8.98 percent).

During the 20 years of the study Period, India had exported a total value of 2358.02 million dollars fresh grapes on an average of 14.37 million dollars per year. Maximum 818.64 million dollars (34.72 percent) fresh grapes were exported to the Netherlands, followed by the United Kingdom (14.95 percent), Russia (10.02 percent), the United Arab Emirates (8.75 percent), Bangladesh (6.71 percent), Germany (4.52 percent), Saudi Arabia (3.15 percent), Thailand (2.6 percent), Belgium (1.49 percent), Nepal (0.91 percent) and other countries (12.19 percent).

India has exported a total of `1379520.12 lakh of fresh grapes with `5717.78 lakh per annum. The country had exported maximum `482791.84 lakh fresh grapes (35 percent) to the Netherlands, followed by the United Kingdom (14.26 percent), Russia (10.72 percent), the United Arab Emirates (8.29 percent), Bangladesh (6.28 percent), Germany (4.85 percent), Saudi Arabia (3.20 percent), Thailand (2.72 percent), Belgium (1.35 percent), Nepal (0.89 percent) and other countries (12.44 percent) in the 20 years of the study period.

The top ten countries in terms of their share in total fresh grapes export value remained more or less the same during the study period, and together, they contribute more than 85 percent of the total export of India.

The export of fresh grapes from India in quantity, value in US dollars and value in rupees have been continuously increasing at a good pace having little bit ups and downs.

The direction of trade and changing export pattern of fresh grapes

The structural change in the export direction of Indian fresh grapes was examined by estimating the transitional probability matrix using the first-order Markov chain model. For this purpose, the study period was divided into two periods (Period-I: 1999-00 to 2008-09 and Period-II: 2009-10 to 2018-19). Deshmukh *et al.*, (2018) ^[2], Sathyendra Kumar and Devaraj (2020) ^[1] also focused the Indian grapes trade direction in their study.

Export Trade Pattern during the Period-I (1999-00 to 2008-09)

It is evident from Table 1 that, for Period-I, Bangladesh was the most stable market of Indian fresh grapes as reflected by the high probability retention of 0.7628. As such Bangladesh retained 76.28 percent of its previous market share during Period-I (1999-00 to 2008-09). It lost 20.34 percent, 2.52 percent and 0.86 percent market shares to the Netherlands, Saudi Arabia and UAE, respectively. However, it gained 100 percent export shares from both Germany and Thailand, 92.38 percent from Nepal and 10.58 percent from the Netherlands. The UK was the second most stable market for Period-I by retaining 56.83 percent of its previous market share. Nevertheless, it lost shares of 20.63 percent and 21.21 percent shares to UAE and 'other countries', respectively, by gaining 45.59 percent from UAE. On the other hand, UAE, Netherlands, Saudi Arabia and Russia retained their previous export shares 43.46 percent, 39.45 percent, 38.39 percent and 9.65 percent, respectively.

It is clear that during the study Period-I, Bangladesh and UK were highly stable market, UAE, Netherlands, Saudi Arabia were moderately stable markets, and Russia was a less stable market for fresh grapes export of India. On the contrary, Germany, Nepal, Thailand and 'other countries' had the probability retention of zero, showing that they were the most unstable importers of Indian fresh grapes in Period-I over the previous Period.

Table 1: Trade direction of fresh grapes export from India to major destination during Period-I of the study

Countries	Bangladesh	Germany	Nepal	Netherlands	Russia	Saudi Arabia	Thailand	UK	UAE	Others
Bangladesh	0.7628	0.0000	0.0000	0.2034	0.0000	0.0252	0.0000	0.0000	0.0086	0.0000
Germany	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Nepal	0.9238	0.0000	0.0000	0.0000	0.0762	0.0000	0.0000	0.0000	0.0000	0.0000
Netherlands	0.1058	0.1409	0.1359	0.3945	0.0174	0.0000	0.0049	0.0000	0.0000	0.2004
Russia	0.0000	0.0000	0.0000	0.9033	0.0967	0.0000	0.0000	0.0000	0.0000	0.0000
Saudi Arabia	0.0000	0.0000	0.0000	0.2092	0.0000	0.3839	0.0000	0.0000	0.4069	0.0000
Thailand	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0192	0.0000	0.5683	0.2003	0.2121
UAE	0.0000	0.0396	0.0000	0.0554	0.0000	0.0000	0.0000	0.4559	0.4346	0.0143
Others*	0.0000	0.0000	0.0026	0.7915	0.0000	0.0000	0.0000	0.0000	0.2058	0.0000

*All other remaining importing countries like Hong Kong, Canada, Malaysia, Oman, Thailand, China, Finland, Qatar, Sri Lanka, Spain, Switzerland, Lithuania, Singapore, Ireland, Bahrain, Austria, Kuwait, Sweden, Portugal, Denmark, Taiwan, Norway, Latvia, Italy, Romania, Ukraine, Iraq, Belarus, Belgium, Poland, Indonesia, Afghanistan, Jordan, Bhutan, Turkey, Kenya, Maldives, Slovenia, Czech Republic, Mauritius, Pakistan, U S A, Senegal, Cambodia, Comoros, Seychelles, Argentina, Australia, Bahamas, Brazil, Brunei, Cayman, Egypt, France, Greece, Liberia, Madagascar, Morocco, Myanmar, Panama Republic, Philippines, South Africa, Vietnam, Zambia are grouped under the category of the 'others'.

Table 2: Trade direction of fresh grapes export from India to major destinations during Period-II of the study

Countries	Bangladesh	Germany	Nepal	Netherlands	Russia	Saudi Arabia	Thailand	UK	UAE	Others
Bangladesh	0.4921	0.0000	0.0462	0.0000	0.0811	0.0351	0.0220	0.1143	0.1731	0.0361
Germany	0.2335	0.5617	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2048
Nepal	1.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Netherlands	0.0000	0.0476	0.0000	0.4838	0.0884	0.0250	0.0381	0.0000	0.0768	0.2405
Russia	0.0000	0.0000	0.0000	0.5848	0.0000	0.0000	0.0468	0.3685	0.0000	0.0000
Saudi Arabia	0.0000	0.0000	0.0000	0.0000	0.5242	0.0000	0.0000	0.4758	0.0000	0.0000
Thailand	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UK	0.4951	0.0000	0.2477	0.0000	0.0000	0.0000	0.0000	0.0000	0.2572	0.0000
UAE	0.0000	0.0000	0.0000	0.7934	0.0000	0.0106	0.0287	0.1673	0.0000	0.0000
Others*	0.0000	0.0000	0.0000	0.0000	0.4787	0.2625	0.0000	0.0000	0.0000	0.2587

*All other remaining importing countries like Hong Kong, Canada, Malaysia, Oman, Thailand, China, Finland, Qatar, Sri Lanka, Spain, Switzerland, Lithuania, Singapore, Ireland, Bahrain, Austria, Kuwait, Sweden, Portugal, Denmark, Taiwan, Norway, Latvia, Italy, Romania, Ukraine, Iraq, Belarus, Belgium, Poland, Indonesia, Afghanistan, Jordan, Bhutan, Turkey, Kenya, Maldives, Slovenia, Czech Republic, Mauritius, Pakistan, U S A, Senegal, Cambodia, Comoros, Seychelles, Argentina, Australia, Bahamas, Brazil, Brunei, Cayman, Egypt, France, Greece, Liberia, Madagascar, Morocco, Myanmar, Panama Republic, Philippines, South Africa, Vietnam, Zambia are grouped under the category of the 'others'.

Table 3: Country-wise actual and predicted fresh grapes export from India for 1999-00 to 2008-09 (Quantity in tonnes)

Year	Bangladesh		Germany		Nepal		Netherlands		Russia	
	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
1999-00	798.39	1032.82	344.64	255.94	0	104.22	748.26	1496.68	0	13.02
2000-01	1550.32	1758.03	327.99	508.6	0	306.4	2206.56	3549.14	0	38.39
2001-02	232.21	624.51	280.26	413.8	0	219.83	1579.55	2640.1	0	27.48
2002-03	526.66	2050.76	724.86	1018.5	385.52	736.26	5368.77	4715.44	0	122.79
2003-04	2125.55	6794.71	2381.01	869.95	2409.2	671.95	4883.85	5284.86	127	280.84
2004-05	14724.37	14507.8	1151.39	1264.92	1440.35	1026.37	7505.31	8595.65	410.55	280.05
2005-06	13933.09	16218.07	2992.48	1986.46	1422.17	1658.97	12132.62	11982.46	901.1	406.61
2006-07	25748.94	30269.64	6126.57	3002.36	2610.3	2605.55	19020.63	20796.61	1202.2	646.12
2007-08	37857.34	36675.28	2162.15	3818.55	3192.14	3325.31	24378.87	22644.34	628.79	728.24
2008-09	54376.77	49217.12	1261.86	3855.41	3892.63	3328.62	24340.68	28103.05	0	720.15

Table 4: Country-wise actual and predicted fresh grapes export from India for 1999-00 to 2008-09 (Quantity in tonnes)

Year	Saudi Arabia		Thailand		UK		UAE		Others	
	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
1999-00	274.09	260.99	0	3.67	7065.05	5747.88	3800.85	3385.89	974.34	1702.8
2000-01	477.43	386.84	14	10.81	8567.14	7144.73	4992.38	4609.89	2510.25	2330.68
2001-02	620.8	340.99	0	7.74	5042.39	5067.27	4829.31	3772.23	1986.51	1455.09
2002-03	489.22	371.73	0	26.31	8887.83	8067.71	6617.14	5385.22	2553.89	3055.64
2003-04	239.29	270.14	50	23.93	6495.33	5784.51	4591.38	4063.85	3167.03	2422.04
2004-05	149.78	540.26	0	36.78	5818.14	5694.42	5237.93	4063.85	2460.52	2812.99
2005-06	344.95	700.22	0	59.45	11285.5	9602.22	6994.24	4135.73	3902.14	4925.05
2006-07	1115.45	1337.82	78	93.2	13579.43	11428.34	8140.28	6363.43	7941.08	6808.34
2007-08	2402.61	2099.25	107.37	119.46	11608.64	11013.04	9686	8567.32	4699.28	7486.23
2008-09	2558.9	2595.97	305.4	119.27	12672.55	12103.98	10752.73	8805.05	7971.44	7719.48

Table 5: Country-wise Actual and Predicted fresh grapes export from India for 2009-10 to 2018-19 (Quantity in tonnes)

Year	Bangladesh		Germany		Nepal		Netherlands		Russia	
	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
2009-10	44419.21	33761.16	1605.37	2273.66	4443.46	5596.39	28821.9	23232.32	745.81	12091.67
2010-11	38051.99	26710.52	650.19	1230.9	4411.53	3469.93	18186.83	18390.28	2035.98	10554.05
2011-12	35640.43	25552.44	599.27	1211.58	4623.8	3272.6	18381.7	21442.9	4610.81	10689.37
2012-13	32562.09	27355.56	1464.06	2531.91	3647.82	5177.63	35914.78	40546.78	15885.32	15628.09
2013-14	31108.9	27742.54	2419.32	3552.43	3600.23	5574.09	46081.91	47943.48	23277	17875.39
2014-15	3473.02	10918.38	2558.29	2999.43	2079.64	3428.59	32824.42	34519.79	12344.78	10105.2
2015-16	7831.79	18836.21	4222.37	4770.29	5283.45	4720.87	50390.44	44080.15	12445.66	14931.08
2016-17	38106.99	34979.65	10467.38	8498.02	7059.54	5124.34	55010.43	55769.99	22340.94	23986.93
2017-18	5073.32	23307.17	16449.51	12022.24	7763.62	4840.18	58456.97	60138.47	27434.39	23162.9
2018-19	46419	41204.33	15739.17	12280.37	5974.26	6503.29	72262.13	66728.65	30293.17	30273.54
2019-20	-	41027.1	-	10074.17	-	7596.93	-	69915.05	-	30131.21
2020-21	-	42311.00	-	8986.62	-	7985.29	-	71246.26	-	28824.98
2021-22	-	42896.51	-	8439.10	-	7954.20	-	71735.43	-	28555.43

Table 6: Country-wise Actual and Predicted fresh grapes export from India for 2009-10 to 2018-19 (Quantity in tonnes)

Year	Saudi Arabia		Thailand		UK		UAE		Others	
	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
2009-10	3655.97	4593.35	875.64	2398.78	14308.53	8773.42	10053.56	13582.64	8408.09	11039.15
2010-11	3239.19	4167.88	1280.29	1882.92	6911.3	8142.28	8974.74	9761.13	8695.07	8130.18
2011-12	4276.87	3974.2	1807.15	1991.28	6564.45	9504.4	10141.52	9269.45	8214.02	7955.12
2012-13	5905.77	5869.89	2956.8	3223.34	14829.49	14689.18	13769.44	12208.9	14030.99	13742.65
2013-14	7241.85	6457.88	3748.89	3829.28	16701.08	17326.59	10445.9	13219.56	15631.16	16744.99
2014-15	3805.48	3766.68	2260.11	2236.1	13193.92	8688.18	11545.24	6515.57	10292.52	11206.26
2015-16	5486.93	5478.02	3146.12	3010.21	17598.08	10048.25	11692.6	9751.89	14550.16	17030.5
2016-17	7308.91	9558.74	4509.7	4398.74	13580.14	18507.92	14597	14313.93	25490.28	23343.73
2017-18	9482.96	8699.8	5043.03	4012.35	18594.24	17472.53	13574.9	10150.13	26348.22	24427.19
2018-19	9203.74	11959.17	3919.42	5558.68	17596.82	22984.63	12772.08	18110.76	31954.01	30544.65
2019-20	-	11324.43	-	5385.44	-	24585.56	-	18168.88	-	27952.64
2020-21	-	10718.09	-	5497.95	-	24220.57	-	18794.67	-	27590.19
2021-22	-	10707.92	-	5533.74	-	23702.17	-	19025.28	-	27640.19

Export Trade Pattern during Period-II (2009-10 to 2018-19)

It is evident from Table 2 that, for Period-II, Germany was the most stable market of Indian fresh grapes with a high probability of retention 0.5617 of the export quantity. As such, Germany retained 56.17 percent of its original export share. However, it lost 23.35 percent export share to Bangladesh and 20.48 percent share to ‘other countries’. It gained export shares of 4.76 percent from the Netherlands. Bangladesh followed it, Netherlands and ‘other countries’ with retention of previous export shares of 49.21 percent, 48.38percent and 25.87 percent, respectively. The results are in line with Mohammadullah *et al.* (2021) [5].

So, it is clear that during the study Period-II, Germany, Bangladesh, Netherlands were moderately stable markets and ‘other countries’ were a less stable market for fresh grapes export from India. On the other hand, Nepal, Russia, Saudi Arabia, Thailand, UK and UAE had the probability retention of zero; it means they were the unstable importers of Indian fresh grapes in the Period-II over the previous Period.

Projection of Fresh Grapes Export from India for 2019-20 to 2021-22

Forecasting is a technique that uses historical data as inputs to make informed estimates that are predictive in determining the direction of future trends (investopedia.com). Naik and Hosamani (2013) [6] forecasted export dimensions of Indian turmeric. Rede *et al.* (2016) [8] studied forecasting Pomegranate export from India.

Table 5 & 6 show that in 2019-20 predicted quantities of fresh grapes exported from India to Bangladesh, Germany, Nepal, Netherlands, Russia, Saudi Arabia, Thailand, UK, UAE, and other countries are 41027.10, 10074.17, 7596.93, 69915.05, 30131.21, 11324.43, 5385.44, 24585.56, 18168.88 and 27952.64 tonnes, respectively. In 2020-21 forecast quantity for Bangladesh, Germany, Nepal, Netherlands, Russia, Saudi Arabia, Thailand, UK, UAE and other countries are 8986.62, 7985.29, 71246.26, 28824.98, 10718.09, 5497.95, 24220.57, 18794.67 and 27590.19 tonnes, respectively. In 2021-22 predicted quantity of fresh grapes export from India to Bangladesh, Germany, Nepal, Netherlands, Russia, Saudi Arabia, Thailand, UK, UAE and other countries are 8439.10, 7954.20, 71735.43, 28555.43, 10707.92, 5533.74, 23702.17, 19025.28 and 19025.28 tonnes, respectively.

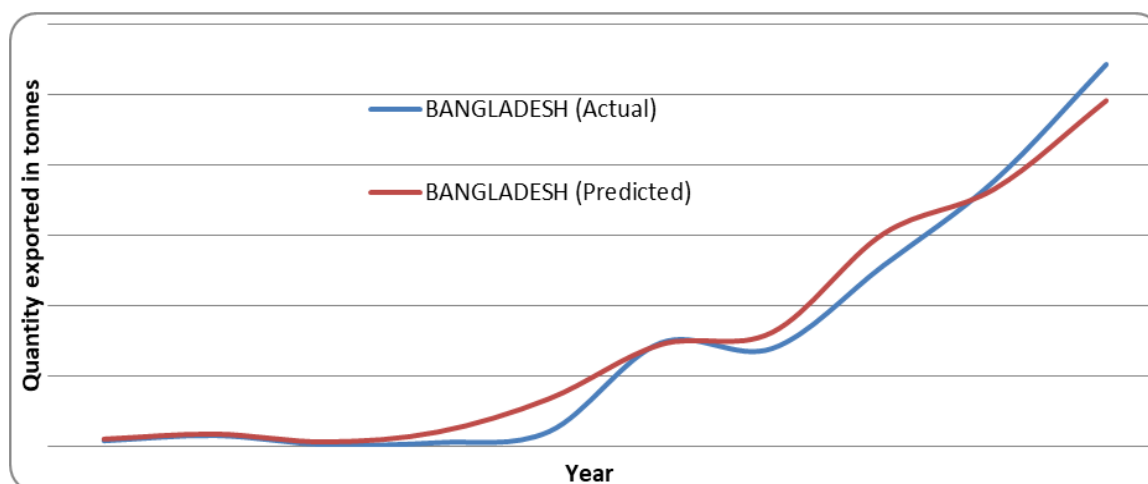


Fig 1: Actual and Predicted trends of the export quantity of the most stable country in Period I

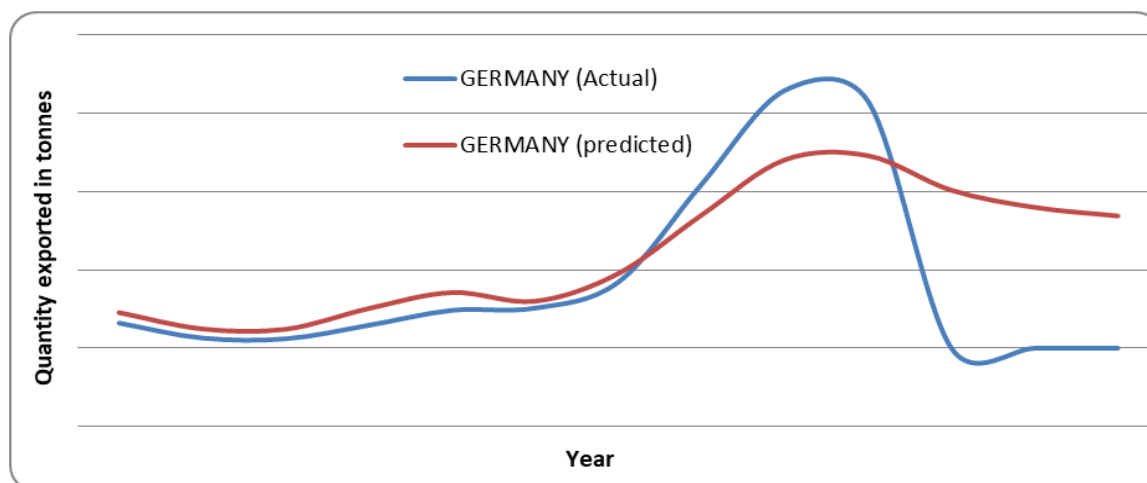


Fig 2: Actual and Predicted trends of the export quantity of the most stable country in Period II

Conclusions

The results showed that for Period-I, Bangladesh and UK were highly stable markets of Indian fresh grapes. UAE, Netherlands, Saudi Arabia were moderately stable markets, and Russia was the least stable market for fresh grapes export of India. On the contrary, Germany, Nepal, Thailand and 'other countries' were unstable importers of Indian fresh grapes during the Period-I. For Period-II, Germany, Bangladesh, Netherlands and 'other countries' were stable markets for fresh grapes export from India. In contrast, Nepal, Russia, Saudi Arabia, Thailand, UK and UAE were the unstable importers of Indian fresh grapes. Although Indian fresh grapes are exported to more than 50 countries, exports are mainly concentrated in the Netherlands, Bangladesh, the United Kingdom and the United Arab Emirates. High dependence on one or two export markets would increase the trade risk in the long run. There is a need to diversify the geographical concentration.

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