Original Research Article

Growth Performance and Export Destination of Indian Fruits: Evidence from Markov Chain Approach

Abstract

India's exports of fruits are rising but low when compared with production. India has a large range of varieties of fruit in its basket and accounts for 13 % of world's total fruit production. The overall objectives of the study were to determine the growth trends and export destination of major fruits in world. The study were used the secondary data of Mango, Banana, Grapes Orange and apple from 2001-02 to 2015-16. CAGR and Markov Chain analysis were employed for the analysis. The study concluded that the growth rate of export of banana, Mango, Orange, Grapes and Apple was higher in Iran, Bangladesh, Nepal, Russian Federation and UAE in terms of value and quantity respectively. The results of markov chain analysis indicated that the Saudi Arabia as a stable destination for Banana, Bahrain for mango, UAE, for grapes, Bangladesh for orange, Nepal for apple.

Key words: Markov chain, Growth rate, Export and Fruits

Introduction

In agriculture %share of horticulture output is more than 30 % over the last decade. The area under horticulture grew by about 1.8 % per annum in 2020-21 and annual production increased by 3.3 %, the foreign trade policy 2004-09 also emphasized on boosting agricultural exports and recognised the growth and promotion of exports of horticultural products was important for the country.

India produced 331.05 million tonnes of fruits. The area under cultivation of fruits stood at 25.66 million hectares. The vast production base offers India tremendous opportunities for export. During 2019-20 India exported fruits worth of US$. 1,277.09 million

Fruits are excellent source of energy because fruits are generally high in fibre, water, vitamin C and sugars and fruits have important role in fight against different diseases or reduce the risk of diseases like cancer, cardiovascular disease (especially coronary heart disease), stroke, Alzheimer disease and cataracts etc. Some fruits which are rich in potassium like banana, papaya, mango, raisins and orange are very helpful to reduce the chance of developing kidney stone. There are many different kinds of fruits in the world and every fruit has its own quality and taste. Fruits are low in calories so they are also very helpful in weight loss diet.

It is generally stated that standard of living of people of a country can be judged by its per capita production and consumption of fruits. India has a large range of varieties of fruit in its basket and accounts for 13 % of world's total fruit production.

The major fruits growing states in our country are Uttar Pradesh, Andhra Pradesh, Bihar, Karnataka, Tamil Nadu, Maharashtra, Kerala and West Bengal and other states, which have substantial area under fruit crops are Gujarat, Assam, Madhya Pradesh and Orissa. The per capita consumption of fruits in India is only around 46 gm/day against a minimum requirement about 92g/day recommended by Indian Council of Medical Research and National Institute of Nutrition, Hyderabad.

India's exports of fruits are rising but they still remain abysmally low when compared with production. Among fruits, India stood first in the global production of Banana and Mangoes, Guava, Pineapple, Orange, Apple and in Grape. The major fruits exported from India are mango, grapes, orange, apple, banana and mosambi. The major share of India's exports of fresh fruits goes to Bangladesh, Nepal, UAE, UK and Malaysia. As reported by times of India in 2020 the export of fresh fruits and processed products have risen 23.24 % in value terms to Rs 25,500 crores. In spite of being one of the largest producers of fruits in the world, India's share in the value of world exports in many fruits is ridiculously low at much less than one %. It might be because of competitiveness of other countries. There is still a huge unexplored and unexploited potential in terms of specific fruit products and their quantities. There are still several untapped markets particularly in developing countries which can be exploited to improve the fruit exports.

Methodology

The changes in the export of major fruits to different countries were analysed by employing a first order finite Markov chain model which captured the net effect in changes in the exports of major fruits cotton over a period of time. There is a growing awareness of the usefulness of this technique for analysis and forecasting in many areas including exports, particularly when the process is constant but has a gradual change (Eswarprasad et al., 1997).

Growth rate analysis

Growth rate on quantity and value of major fruit crops were computed for a period of 15 years from 2001-02 to 2015-16 depending upon the availability of data. The linear, log-linear, exponential and power functions are some of the important functional forms employed to study the growth rates. Different functional forms were tried in the past for working out the growth rates in area, yield and production by Chengappa (1981), Sikka*et al.* (1985) and Biechee*t al.*

(1992). Some of the important forms tried were the linear growth model (Y = a + bt), exponential function (Y = abt) and quadratic function (Y = a+bt+ct2). However, it was found that the exponential form of the function Yt = abt is the better and most frequently used one. In the present study, compound growth rates in area, production, yievld and import and exports of pulses were estimated by specifying the following relationship.

Yt = abtUt …… (1.1)

Where,

Yt = area, production, yield, quantity and value of pulses imported and exported in year„t"

t = year which takes value 1, 2, ……..n

Ut = disturbance term in year„t"

„a" and „b" are parameters to be estimated.

The equation (1.1) was transformed into log- linear form and written as:

log Y = log a + t log b + log Ut …….. (1.2)

Equation (1.2) was estimated by using ordinary least square (OLS) technique.

Compound growth rate (g) was then estimated by the identity given in equation (1.3).

g = (b-1) 100 ……..…… (1.3)

Where,

g = estimated compound growth rate in % per annum.

b = antilog of log b

The standard error of the growth rate was estimated and tested for its significance with „t" statistic.

Markov chain analysis

In this paper, the structural change in raw major fruits export from India in terms of market retention and market switching was examined by using the Markov chain approach. The estimation of the transitional probability matrix (P) was central to this analysis. The element Pij of the matrix indicated the probability that the exports would switch from the ith country to jth country over a period of time. The diagonal elements Pij indicated the probability that the export share of a country would be retained in the successive time periods, which in other words, measured the loyalty of an importing country to a particular exporting country. In the context of the current application, there were twelve major importing countries for Indian cotton, viz. UAE, Kuwait,Oman, Saudi Arabia,Nepal,Pakistan, Qatar,Bahrain, Iran Islamic republic, Maldives and Others. The average exports to a particular country was considered to

be a random variable which depended only on its past exports to that country and which was denoted algebraically by Eq. (1):

$$E_{jt} = \sum_{i=1}^{r} E_{it-1} P_{ij} + e_{jt} \qquad \ldots(1)$$

where,

Ejt = Exports from India to jth country during the year t.

Eit-1 = Exports to ith country during the period t-1.

Pij = Probability that the exports will shift from ith country to jth country.

ejt = The error term which is statistically independent of Eit-1.

t = Number of years considered for the analysis

r = Number of importing countries

The transitional probabilities Pij which can be arranged in a (c * r) matrix have the following properties.

$$O \leq Pij \leq$$

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.

Results and Discussion

In order to know current performance of fresh fruits in the international market, their direction and magnitude of change in exports, keeping in view these issues, we have selected some fruits such as Banana, mango, grapes, orange, apple. These fruits will alone contribute nearly 50 to 55 % of area and 60 to 65 % of output to total fruits. Hence, these crops were selected. We analysed the Trends and dynamics of change in the export. Trends in export of value and quantity were estimated by using compound growth model and trade directions of commodities exports were analysed using the first order Markov chain approach. Central to Markov chain analysis is the estimation of the transitional probability matrix P. The elements Pij of the matrix P indicates the probability that export will switch from country i to country j with the passage of time. 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 loyalty.

Growth rate

The major importing countries of Indian banana UAE, Kuwait, Oman, Bangladesh, Nepal, Saudi Arabia, Pakistan, Qatar, Bahrain, Iran, Maldives and others have been presented in Table(1). The results revealed that the growth rate of export of banana was high in Iran in

terms of value (45.35 %)and quantity (49.85%) followed by Oman-value (29.45%) quantity (26.43%), Qatar- value (28.51%) quantity (20.40%), Kuwait- value (29.72%), quantity (-26.94%), UAE- value (26.67%), quantity (37.54%), Nepal- value (26.67%), quantity (11.70%), Bahrain- value (23.95%), quantity (15.11%), Maldives -value (19.38%), quantity (12.31%), Pakistan- value (10.06%), quantity (57.49%), Saudi Arabia- value (4.75%), quantity (24.56%), Others -value (26.76%), quantity (13.86%). Consumers in West Asia appear to have taken a liking for bananas from India and Affinity to the West Asian markets has offered a huge opportunity for Indian exporters to boost their banana consignments to the region. Similar work related to the present investigation was also carried out by Jadhav et al. (2003) and Rana (1985).

Table1 revealed that the growth rate of export of mango was high in Bangladesh in terms of value (42.66%)and quantity (29.59%) followed by UAE-value (22.26%) quantity (18.44%), USA- value (20.89%) quantity (3.77%), Singapore- value (17.14%), quantity (9.45%), Kuwait- value (16.04%), quantity (9.36%),UK- value (14.25%), quantity (3.14%),Oman- value (12.32%), quantity (0.26%),Bahrain- value (8.45%), quantity (1.46%),Saudi Arabiavalue (8.40%), quantity (-1.56%),Netherland- value (-15.64%), quantity (-20.64%), Others- value (0.00%), quantity (0.00%).Nearly 40 % of the total mango production in the world and nearly 30 varieties of mangoes are grown in India, Interestingly, in spite of the high returns that the US market gives, exports to that country did not go up once the ban on Indian market was lifted.export of mango was increasing to other countries The US market would fetch an exporter four times the price than to any other country. Growth in value of exports was found to be very high indicating good potential and higher profit for Indian mangoes. These results are in accordance with findings of Yeledhalli et al, (2012).

The major importing countries of Indian orange UAE, Cameroon , Oman, Bangladesh, Thailand ,USA, Saudi Arabia, Nepal, Canada, Germany, and others have been presented in Table(1).The results revealed that the growth rate of export of orange was high in Nepal in terms of value (25.48%)and quantity (16.40%) followed by UAE- value (10.73%) quantity (0.16%), Germany- value (8.91%) quantity (2.99%), Cameroon- value (7.98%), quantity (11.36%), Oman -value (4.22%),quantity (3.54%),UK value (14.25%), quantity (3.14%), Thailand- value (2.20%), quantity (-7.94%),Bangladesh- value (1.72%), quantity (--4.84%), Canada and Saudi Arabia showing the negative growth rate both have value as quantity, Others-value (3.82%), quantity (0.07%).

Among the major importing countries of Indian grape, the growth rate of export of grapes was high in Russian Federation in terms of value (51.13%)and quantity (102.65%)

followed by Thailand- value (43.22%) quantity (120.54%), Saudi Arabia- value (40.95%) quantity (36.26%), Bangladesh- value (40.84%), quantity (37.95%), Netherland-value (30.63%) quantity (27.77%),Srilanka-value (23.17%), quantity (20.43%),UAE- value (17.80%) quantity (9.41%), Germany- value (15.50%), quantity (12.83%),UK- value (12.77%) quantity (10.33%), Belgium- value (12.06%), quantity (9.86%), Others- value (34.89%) quantity (-31.40%). Grapes were exported to European Union and Gulf countries because of high price, taste and flavour. These results are in accordance with findings of K N Nithin in (2015)

The major importing countries of Indian apple UAE, China, Bangladesh, Kuwait, Congo Saudi Arabia, Srilanka, USA, Nepal, Germany and others have been presented in Table(1). The results revealed that the growth rate of export of apple was high in UAE in terms of value (36.67%)and quantity (-2.32%) followed by Saudi Arabia- value (29.92%) quantity (-5.25%), Srilanka value (25.86%), Quantity (-5.10%) Kuwait- value (21.82%) quantity (-8.36%), USA- value (21.51%), quantity (-17.11%), Nepal- value (17.93%) quantity (23.71%), Bangladesh- value (10.37%), quantity (-14.58%), Germany- value (10.37%) quantity (14.58%),Congo- value (2.08%), quantity (3.13%), %),China- value (1.71%) quantity (11.46%), Others- value (15.07%) quantity (28.03%). Our apple is exported to neighbouring and gulf countries. It might be because of easy transportation and consumer preference.

Markov chain analysis

In case of banana, we can see that over the year UAE has emerged as one of the most highly stable country among the selected major importing countries of India banana as reflected by the high probability of retention. Bahrain, Saudi Arabia Oman, Nepal have also emerged as major importing countries. This trend is highly noticeable trend in 2001 to 2015.Further this trend was reinforced by the Saudi Arabia and UAE as both they could be able to retain 57 and 47 % respectively. Other countries also exhibit loyalty at 90 %. Though Kuwait and Maldives have emerged as major export destination for India banana, they were not showing any loyalty. Iran and Pakistan have shown their lowest loyalty among ten top countries. It is interesting to observe that banana exports are directed mainly to Gulf countries which have a sizable number of Indian workers. Perhaps the increasing export to other countries and retention by major countries could be due to increasing level of acceptance and high export competitiveness of India banana. Mehazabeen A in (2020) also reported in his study UAE had one of the most stable market among the major importers of Indian banana as reflected by higher probability of retention at 0.5496 i.e., the probability that UAE retains its exports share over the study period was 54 %.

When we look at mango, Bahrain has emerged as one of the highest loyalty in retention of its share to the tune of 16.20 % followed by Saudi Arabia by retaining 14.26%, Netherland by retaining its loyalty at 13.08%, Bangladesh retaining its loyalty by 9.34%. UAE is the lowest stable country in retaining its loyalty to the tune of 3.25 %. Apart from the other countries are retaining its loyalty to the tune of 100%. Even though UK, Kuwait, Oman, USA, Singapore have emerged as major destination for Indian mango but they have failed to retain their loyalty. Major gainer among countries are UAE from UK (86.09%), Bahrain (52.42%) followed by Bangladesh from Netherland (86.92%),UK from Bangladesh (30.17%) other from UAE (95.12%),Kuwait, Singapore, USA (100%),Saudi Arabia (81.4%) Oman (82.58%).These findings are comparable with similar findings reported in Asha Bisht in (2015) observed that Saudi Arabia and Bangladesh are more stable market in case of mangoes.

The major Indian grapes importing countries are UAE, Netherland, UK, Saudi Arabia, Thailand, Belgium etc. As we see in the table major share of Indian banana will go to UK. It was able to retain (55.03%) stability during the reference period followed by Russian Federation which retained its stability to the tune of (52.13%), Netherland (50.32%) and Bangladesh (35.94 %). However, UK is going to lose its share of (25.39%)to UAE, Germany (14.63%), Russian Federation has lost its share to Netherland (28.39 %),16.57 % to Thailand ,Netherland lost its share to Bangladesh that is about 18.22%, Bangladesh has lost its share to Netherland (26.85%) and to other (20.14%). The major gainer from the Imports of Indian fresh grapes over the reference period were UAE, it had transfer probability of 100% from Srilanka, 33% from Germany from UK 25.86% and from other 14.22%. Netherland had transfer probability from Russian Federation (28.39%), Bangladesh (26.85%), Germany (51.40%), Belgium(62.86%). Russian Federation had transfer probability from Thailand (84.26%) and others (10.15%). Bangladesh had transfer probability from Netherland (8.25%) and Belgium(28.97%).Germany has transformed from UK(14.63%) Reason for the high stability because of consumer preference taste and flavour and low stability that might because of lot pesticide spray. K Nithin in 2016 observed that Netherland was the most stable market among the major importers of Indian grapes as reflected by the probability of retention at 80.56 %.

In the case of orange we can see that over the year Bangladesh has emerged as one of most stable country by reflecting its highest loyalty to the tune of 97.99% followed by Nepal (71.89%),Cameroon is showing lowest loyalty. Even though UAE, Oman, Saudi Arabia, USA, Thailand, Canada, and Germany have emerged as major export destination but they have failed to gain loyalty. The major gainer among importer of Indian fresh orange over the reference period were UAE from Germany, Cameroon from Thailand, Nepal from UAE, and Bangladesh

from Other countries 100 %. UAE and Oman showed highest lost to Nepal that is about 100% followed by Thailand and Germany lost its100% share to Cameroon and UAE respectively. High loyalty is because of good flavour and taste of Indian orange. Low loyalty because competitiveness and fall in the demand.

In case of apple, we come across Nepal as the highest/most stable country. This is reflected by its loyalty which is about 100% and other countries also showing 100 % loyalty in importing Indian fresh apple. Among the selected countries all are showing no loyalty towards Indian apple import except Nepal even though they are the major destination. The major gainers among the importer of Indian apple were - Nepal has gained 100% from Congo and other countries have gained 100 % from Saudi Arabia, USA, Srilanka and china. Among the countries all most all have lost their share to other countries and only a few of them lost their share to selected countries such as Bangladesh and it has lost its share to Nepal (28.55%),Germany has lost to Nepal (95.65%) and Kuwait has lost Nepal(10.40%). High stability because of it's being near to India and low stability is due to increasing demand and production being less it is restricted to only few parts of India.

Conclusion

Since the cost of production is escalating in developed countries, they would like to shift their production bases to countries like India. In order to encourage this, India has to attract foreign direct investments (FDI) through appropriate policy modifications including changes in land laws and taxation laws. Foreign direct investment in multi-brand retail would help in establishing backward-forward linkages to increase exports. This will augment farmers' income and helps in employment generation. Chile has been largely benefited with multi-brand retail in pushing its exports of wine and fruits across the globe. The multinational retailing will enable Indian fruits growers to access the world market as efficient producers, this will help to establish producer seller linkages in the world market which would be more remunerative to India producers.

References

Anonymous. Horticultural statistics at a glance. *Ministry of Agriculture & Farmers Welfare*, India. 2016: 1-453

Bieche B, Covis M, Agrerich CA. Fourth international symposium on processing tomatoes. *Acta Horti*. 1992; 23-31.

Chengappa PG. Growth rate of area, production and productivity of coffee in India. *Journal of Coff Res;* 1981:11(4): 19-26.

Eswaraprasad Y, Achoth L, Radha Y. Farm technology in relation to changing structure of landholding. *Agril Econ Res Rev*. 1997; **10**(2): 78-87.

Reddy MHN. Export competitiveness and performance of selected fresh fruits and vegetables from India.–An economic analysis. *M. Sc Thesis (unpublished)*, Univ. Agric. Sci., Bengaluru. 2007.

Sikka BK, Vaidya CS. Growth rates and cropping pattern changes in agriculture in Himachal Pradesh. *Agri Situ in India*. 1985; **39**(11): 843-846

Yeledhalli RA, Patil PH, Chidanand P, Naik VR. Changing direction and magnitude of India's major export to middle- east countries. *Int J Agri Stat Sci* 2012; 8: 651-58.

Bisht A, Singh R, Gangwar A, Singh OP. Export of Fruits from India: Growth, Pattern and SPS. Issues *econ affa*. 2015; **60**(2): 339-346

Jadhav MS, Kumbar SS, Ghadake VL, Bondar US. Export competitiveness of fruits. *Indian J. Agril. Mktg*. 2003; 17: 190.

Rana RS. India – A potential export of horticultural produce. *Indian J. Mktg*. 1985; **15** (10) : 21-24.

Mehazabeen A, Srinivasan G. Export performance of banana in India – A markov chain analysis *Pt Arch.*2020; **20** (2) : 3836-3838.

Nithin KN. Production and Export Performance of Grapes from India: An Econometric Analysis. *Res J of Agri Sci.* 2016; 7: 143-146

Table 1: Destination -wise growth rates in export of fresh fruits from India during 2001-02 to 2015-16

Banana			**Mango**			**Orange**			**Grapes**			**Apple**		
Countries	Qty	Value	Countries	Qty	Value	Countries	Qty	Value	Countries	Qty	Value	Countries	Qty	Value
UAE	**37.54***	**26.67***	UAE	18.44	22.26*	UAE	0.16	10.73	UAE	09.41*	17.80*	Bangladesh	-14.58	10.37
Kuwait	**-26.94**	**29.72***	Bangladesh	-29.59*	42.66*	Cameroon	-11.36	7.98	Netherland	27.77*	30.63*	Nepal	23.71	17.93*
Oman	**26.43***	**29.45***	Saudi Arabia	-1.56	08.40*	Oman	3.54	4.22	UK	10.33*	12.77*	UAE	-2.32	36.67*
Saudi Arabia	24.56*	4.75	UK	3.14	14.25*	Saudi Arabia	-2.23	-2.04	Saudi Arabia	36.26*	40.95*	Saudi Arabia	-5.25	29.92*
Nepal	11.7	26.67*	Kuwait	9.36	16.04*	Nepal	16.40*	25.48*	Thailand	85.58*	51.42*	USA	-17.11*	21.51
Pakistan	57.49*	10.06	Bahrain	1.46	08.45*	USA	-13.82	-0.74	Belgium	9.86	12.06	Germany	-14.58	10.37
Qatar	**20.40***	**28.51***	Oman	0.26	12.32*	Thailand	-7.94	2.20	Russian Federation	75.65*	51.13*	Srilanka	-5.10	25.86*
Bahrain	15.11*	23.95*	USA	3.77	20.89*	Bangladesh	-04.84*	1.72	Bangladesh	37.95*	40.84*	Congo	3.13	2.08
Iran	**49.85***	**45.35***	Singapore	09.45*	17.14*	Canada	-5.89	-1.65	Srilanka	20.43*	23.17*	Chain	11.46	1.71
Maldives	12.31*	19.38*	Netherland	-20.64*	-15.64*	Germany	2.99	8.91	Germany	12.83*	15.50*	Kuwait	-8.36	21.82
Others	13.86*	26.76*	Others	0.00	0.00	Others	0.07	3.82	Others	-31.4	34.89*	Others	28.03	15.07*
Total	23.06*	33.20*	Total	-7.96	1.27	Total	-04.14*	2.43	Total	17.98*	25.39*	Total	7.64	16.11*

*Significant at 5% level

Table 2: Transitional probability matrix of Indian banana exports (2001-02 to 2015-16)

Countries	UAE	Kuwait	Oman	Saudi Arabia	Nepal	Pakistan	Qatar	Bahrain	Iran Islamic republic of	Maldives	Others
UAE	**0.5751**	0.0000	0.0000	0.1374	0.0000	0.0000	0.0806	0.0295	0.0000	0.0000	0.1774
Kuwait	0.1779	**0.0000**	0.1133	0.0000	0.0000	0.0000	0.1999	0.1983	0.3106	0.0000	0.0000
Oman	0.5856	0.0000	**0.3992**	0.0000	0.0000	0.0000	0.0152	0.0000	0.0000	0.0000	0.0000
Saudi Arabia	0.0000	0.0971	0.0000	**0.4366**	0.0313	0.0000	0.0000	0.0000	0.2921	0.0000	0.1428
Nepal	0.2952	0.0738	0.0000	0.0000	**0.3957**	0.0000	0.1107	0.0915	0.0000	0.0000	0.0332
Pakistan	0.0000	0.0000	0.3450	0.0000	0.0000	**0.0174**	0.0000	0.0000	0.6376	0.0000	0.0000
Qatar	0.0000	0.7508	0.2492	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0000
Bahrain	0.0000	0.0264	0.0000	0.0000	0.2546	0.0000	0.0000	**0.4723**	0.0000	0.2468	0.0000
Iran Islamic republic of	0.4280	0.2548	0.0767	0.0000	0.0772	0.0000	0.0323	0.0000	**0.0755**	0.0123	0.0432
Maldives	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000
Others	0.0829	0.0000	0.0000	0.0000	0.0121	0.0000	0.0000	0.0000	0.0000	0.0000	**0.9051**

Table 3: Transitional probability matrix of Indian mango exports (2001-02 to 2015-16)

Countries	UAE	Bangladesh	Saudi Arabia	UK	Kuwait	Bahrain	Oman	USA	Singapore	Netherland	Others
UAE	**0.0325**	0.0000	0.0000	0.0086	0.0000	0.0000	0.0000	0.0054	0.0022	0.0000	0.9512
Bangladesh	0.4380	**0.0934**	0.0775	0.3017	0.0508	0.0186	0.0000	0.0000	0.0199	0.0000	0.0000
Saudi Arabia	0.0000	0.0000	**0.1426**	0.0000	0.0000	0.0000	0.0456	0.0000	0.0000	0.0013	0.8104
UK	0.8609	0.0309	0.0056	**0.0000**	0.0275	0.0123	0.0303	0.0213	0.0000	0.0112	0.0000
Kuwait	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Bahrain	0.5242	0.0000	0.0948	0.0000	0.1542	**0.1602**	0.0000	0.0000	0.0000	0.0000	0.0666
Oman	0.0000	0.0000	0.0000	0.0000	0.0000	0.1150	**0.0000**	0.0000	0.0000	0.0592	0.8258
USA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	1.0000

Singapore	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	1.0000
Netherland	0.0000	0.8692	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.1308**	0.0000
Others	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**1.0000**

Table 4: Transitional probability matrix of Indian grapes exports (2001-02 to 2015-16)

Countries	UAE	Netherland	UK	Saudi Arabia	Thailand	Belgium	Russian Federation	Bangladesh	Srilanka	Germany	Others
UAE	**0.0724**	0.5194	0.4082	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Netherland	0.0888	**0.5032**	0.0000	0.0966	0.0000	0.0622	0.0000	0.1825	0.0000	0.0000	0.0666
UK	0.2586	0.0000	**0.5503**	0.0000	0.0000	0.0135	0.0000	0.0000	0.0313	0.1463	0.0000
Saudi Arabia	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Thailand	0.0000	0.0000	0.0000	0.0000	**0.0283**	0.0000	0.8426	0.0000	0.0000	0.0000	0.1291
Belgium	0.0000	0.0817	0.6286	0.0000	0.0000	**0.0000**	0.0000	0.2897	0.0000	0.0000	0.0000
Russian Federation	0.0000	0.2839	0.0000	0.0000	0.1657	0.0000	**0.5213**	0.0000	0.0000	0.0290	0.0000
Bangladesh	0.0000	0.2685	0.0000	0.0758	0.0656	0.0000	0.0292	**0.3594**	0.0000	0.0000	0.2014
Srilanka	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000
Germany	0.3309	0.5140	0.0000	0.0000	0.0000	0.1191	0.0000	0.0000	0.0000	**0.0360**	0.0000
Others	0.1422	0.1191	0.0244	0.0369	0.0135	0.0000	0.1051	0.0000	0.0580	0.0000	**0.5007**

Table 5: Transitional probability matrix of Indian orange exports (2001-02 to 2015-16)

Countries	UAE	Cameroon	Oman	Saudi Arabia	Nepal	USA	Thailand	Bangladesh	Canada	Germany	Others
UAE	**0.0000**	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cameroon	0.0133	**0.0428**	0.0000	0.0000	0.9438	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oman	0.0000	0.0000	**0.0000**	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Saudi Arabia	0.0000	0.0000	0.0818	**0.0000**	0.0000	0.2315	0.0000	0.0000	0.0000	0.0000	0.6867
Nepal	0.0000	0.0000	0.0028	0.0000	**0.7189**	0.0000	0.0000	0.2262	0.0000	0.0000	0.0521

USA	0.0000	0.0000	0.0000	0.0352	0.5908	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.3740
Thailand	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0000
Bangladesh	0.0008	0.0023	0.0020	0.0000	0.0147	0.0000	0.0000	**0.9799**	0.0000	0.0000	0.0002
Canada	0.0000	0.0000	0.1152	0.0230	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.8617
Germany	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000
Others	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**0.0000**

Table 6: Transitional probability matrix of Indian apple exports (2001-02 to 2015-16)

Countries	Bangladesh	Nepal	UAE	Saudi Arabia	USA	Germany	Srilanka	Cango	Chaina	Kuwait	Others
Bangladesh	**0.0000**	0.2855	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7145
Nepal	0.0000	**1.0000**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UAE	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0261	0.0000	0.0000	0.0000	0.9739
Saudi Arabia	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
USA	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Germany	0.0000	0.9565	0.0000	0.0435	0.0000	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000
Srilanka	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000	1.0000
Congo	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	0.0000	0.0000
China	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.0000	1.0000
Kuwait	0.0000	0.1040	0.0050	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**	0.8910
Others	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**1.0000**