Original Research Article

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

Abstract

As we compare with production export of Indian fruits is low. India has a large number of varieties of fruit in its basket and nearly accounts for 13 per cent of the world's total fruit production. The overall focus of this study was to reveal the results of significant fruit growth trends and the export destination of fruits in the world. The study used secondary data on mango, banana, grapes oranges, and apple from 2001-02 to 2015-16. Compound Annual Growth Rate and markov chain analysis were to analyze the growth and destination. The study concluded that the growth rate of export of banana, mango, orange, grapes, and apples was higher in Iran, Bangladesh, Nepal, Russian Federation, and UAE in terms of value and quantity respectively. Markov chain analysis indicated that Saudi Arabia is a stable destination for Banana, Bahrain for mango, UAE, for grapes, Bangladesh for oranges, and Nepal for apples. India has vast potential in the production of many fruits but proper export guidance and training programmes are need to be arranged to farmers, which may help to reach out to the world market.

Keywords: Markov chain, destination, loyalty, quantity &value and export earnings.

Introduction

In agriculture per cent share of horticulture, the output is more than 30 per cent in the last decade. The area under horticulture grew up upto 1.8 per cent per annually in 2020-21 and annual production increased by 3.3 per cent, the foreign trade policy 2004-09 also emphasized boosting agricultural exports and recognized the growth and encouragement of exports of horticultural products were important for the country.

India produced 331.05 mt of fruits. The area under cultivation of fruits has grown to 25.66 million hectares. The more production of fruits offers India tremendous opportunities for export. India exported fruits worth the tune of US$. 1,277.09 million in the year 2019-20.

Fruits are an excellent source of energy because fruits generally have more fiber, water, vitamin C and sugars and fruits have an important role in the fight against different diseases or reduce the risk of diseases like cancer, cardiovascular disease, and cataracts kidney failure, stroke, Alzheimer disease, etc. Some fruits which are rich in potassium like banana, papaya, mango, raisins, and orange are very helpful to reduce the chance of developing a kidney stone.

There are many different kinds of fruits in the world and every fruit has its quality and taste. Fruits are low in calories so they are also very helpful in weight loss.

It is generally stated that the standard of living of the people of a country can be measured by its per capita production and consumption of fruits. India has a large number of varieties of fruit. The major fruits growing states in our countries such as Maharashtra, Uttar Pradesh, Andhra Pradesh, Bihar, Karnataka, Tamil Nadu, Kerala, and West Bengal, and other states, which have a substantial area under fruit crops are Gujarat, Assam, Madhya Pradesh, and Orissa. In India, the per capita consumption of fruits is 46 gm/day against a minimum requirement of about 92g/day recommended by the Indian Council of Medical Research and National Institute of Nutrition, Hyderabad.

India's exports of fruits are rising but they remain dormant stage when compared with production. Among fruits, India was the highest production of bananas in the world followed by Mangoes, Guava, Pineapple, Orange, Apple, and Grape. The significant fruits exported by India are mango, grapes, orange, apple, banana, and mosambi. The major share of India's exports of fresh fruits contributed to Bangladesh, Nepal, UAE, UK, and Malaysia. As reported by the Times of India in 2020 the export of fresh fruits and processed fruit products have reached 23.24 per cent in value terms to Rs 25,500 crores. Despite being one of the largest producers of fruits in the world, India's share in the value of world exports in many fruits is much low due to complications of foreign export policy and lack of awareness of farmers. It might be because of the competitiveness of other countries. There is still a huge untapped potential in terms of specific fruit products and their quantities. There are still several untouched markets, particularly in developing countries which can be exploited to improve fruit exports.

Methodology

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

Growth rate analysis

The growth rate on quantity and value of five major fruit crops were computed for the period of 15 years from 2001-02 to 2015-16. The linear, log-linear, exponential, and power functions

were some of the important functional forms used to analyze the growth rates. Different functional forms were tried in the past for working out the growth rates in the area, yield, and production by Chengappa (1981), Sikka *et al.* (1985), and Bieche *et al.* (1992)., 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 the area, production, yield, and import and exports of pulses were estimated by specifying the following relationship.

$Yt = ab^{t}Ut$ …… (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) was transformed into log-linear form and written as:

log Y = log a + t log b + log Ut …….. (2)

Equation (2) was estimated by using the ordinary least square (OLS) technique.

Compound growth rate (g) was then estimated by the identity given in equation (3).

g = (antilog of b-1) 100 ……..…… (3)

Where,

g = estimated compound growth rate in per cent 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 five major fruits exported from India in terms of market capture and market switching was examined by using the Markov chain analysis. 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 fruits, viz. UAE, Kuwait, Oman, Saudi Arabia, Nepal, Pakistan, Qatar, Bahrain, Iran Islamic

republic, Maldives, and Others. The average exports to a particular country were considered to be a random variable that depended only on its previous exports to that country and which was denoted algebraically by Eq. (1):

$$E_{jt}=\sum_{i=0}^{r} E_{it-1} P_{ij} + e_{it} \quad \text{.....(4)}$$

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.

$$\sum_{i=1}^{n} Pij = 1 \quad and \quad O \leq Pij \leq 1$$

Thus, the expected export shares of each country during period‘t’ were taken by multiplying the export to these countries in the previous period (t-1) with the transitional probability matrix.

Results and Discussion

To know the current performance of fresh fruits in the international market, their direction, and the magnitude of change in exports, we have selected five major fruits crops viz., banana, mango, grapes, orange, and apple. These fruits were contributing nearly about 50 to 55 per cent of the area and 60 to 65 per cent of output in total fruits area and production respectively. We analyzed the trends and dynamics of change in the exports of major fruit crops. Trends in the value and quantity of exported fruits were estimated using a CAGR Model and trade directions of exported fruits were analyzed using the first-order Markov chain analysis. 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 over 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 loyalty toward the exporting country.

Growth rate

Table 1 indicates that the major importing countries of India's banana were UAE, Kuwait, Oman, Bangladesh, Nepal, Saudi Arabia, Pakistan, Qatar, Bahrain, Iran, and Maldives. The study showed that the growth rate of export of banana was higher in Iran in terms of value (45.35 per cent) and quantity (49.85 per cent) followed by Oman (value -29.45per cent and quantity- 26.43 per cent), Qatar (value -28.51per cent and quantity-20.40per cent), Kuwait UAE, Nepal, Bahrain, Maldives, Pakistan and Saudi Arabia. Consumers of West Asian countries are interested and affinity for Indian bananas and this were offered a huge opportunity for Indian exporters to boost their banana consignments to the West Asian markets. The results are in line with Jadhav *et al*. (2003) and Rana (1985).

The growth rate of export of mango (Table 1) was higher in Bangladesh in terms of value (42.66 per cent) and quantity (29.59 per cent) followed by UAE, USA, Singapore, Kuwait, UK, Oman, Bahrain, Saudi Arabia and Netherland. India is contributing nearly 40 per cent of the total mango production in the world and growing about more than 30 mango varieties. Interestingly, in spite of the high returns from the US A market, the exports of Indian mangos to USA were not increased even after lift of ban for Indian mangos, but the exports of mangos were found to be increasing to other countries. The exporter would get four times higher price from USA markets than compared to the price of other country markets. Growth in the value of exports of mangos were found to be very high may indicated a good potential and higher profit for Indian mangoes growers. These results are in line with the findings of Yeledhalli *et al*. (2012).

The study showed that major destinations for Indian (Table 1) orange are UAE, Cameroon, Oman, Bangladesh, Thailand, USA, Saudi Arabia, Nepal, Canada and Germany. The results showed that the growth rate of exports of orange was found to be higher in Nepal in terms of value (25.48per cent) and quantity (16.40 per cent) followed by UAE, Germany, Cameroon, Oman, UK, Thailand, Bangladesh, Canada and Saudi Arabia. The major importing destinations for Indian grape were presented in Table 1. The study showed that, the growth rate of export of grapes was higher in Russian Federation in terms of value (51.13per cent) and quantity (102.65per cent) followed by Thailand, Saudi Arabia, Bangladesh and Netherland. The study showed that more grapes were exported to European Union and Gulf countries because of high price, taste and flavour during study period. These results are in similar with the findings of Nithin (2015).

The major importing destinations (Table 1) of Indian apples are UAE, China, Bangladesh, Kuwait, Congo Saudi Arabia, Srilanka, USA, Nepal and Germany. The study revealed that the growth rate of exports of apples was higher in UAE in terms of value

(36.67per cent) followed by Saudi Arabia (29.92per cent), Srilanka (25.86 per cent), Kuwait (21.82per cent), and USA (21.51per cent). The study showed that the Indian apples are exported more to neighbouring and gulf countries. It might be due to easy transportation and consumer preference.

Markov chain analysis

Table 2 reveals that over the year UAE has emerged as one of the most highly stable countries among the major importing countries of Indian bananas as reflected by the high probability of retention. Bahrain, Saudi Arabia Oman, and Nepal have also emerged as major importing countries. This trend is highly noticeable from 2001 to 2015. Further, this trend was reinforced by Saudi Arabia and UAE as both they could be able to retain 57 and 47 per cent respectively. Other countries also exhibit loyalty at 90 per cent. Though Kuwait and Maldives have emerged as major export destinations for Indian bananas, they were not showing any loyalty. Iran and Pakistan have shown their lowest loyalty among the 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 the increasing level of acceptance and high export competitiveness of the Indian banana. Mehazabeen A (2020) also reported in his study UAE had one of the most stable markets among the major importers of Indian bananas as reflected by a higher probability of retention at 0.5496 i.e., the probability that UAE retains its exports share over the study period was 54 per cent.

In the table 3, Bahrain has emerged as one of the highest loyalty in retention of its share to the tune of 16.20 per cent followed by Saudi Arabia by retaining 14.26per cent, Netherland by retaining its loyalty at 13.08per cent, Bangladesh retaining its loyalty by 9.34per cent. UAE is the lowest stable country in retaining its loyalty to the tune of 3.25 per cent. Apart from the other countries are retaining their loyalty to the tune of 100per cent. Even though the UK, Kuwait, Oman, the USA, and Singapore have emerged as major destinations for Indian mango but they have failed to retain their loyalty. Major gainers among countries are UAE from the UK (86.09per cent), Bahrain (52.42per cent) followed by Bangladesh from Netherland (86.92per cent), the UK from Bangladesh (30.17per cent) others from UAE (95.12per cent), Kuwait, Singapore, USA (100per cent), Saudi Arabia (81.4per cent) Oman (82.58per cent). These findings are comparable with similar findings reported in Asha Bisht (2015) observed that Saudi Arabia and Bangladesh are more stable markets in the case of mangoes.

Table 4 showed that Indian grapes importing countries are UAE, Netherland, UK, Saudi Arabia, Thailand, Belgium, etc. As we see in the table major share of Indian bananas will

go to the UK. It was able to retain (55.03per cent) stability during the reference period followed by the Russian Federation which retained its stability to the tune of (52.13per cent), the Netherland (50.32per cent), and Bangladesh (35.94 per cent). However, the UK is going to lose its share of (25.39per cent)to UAE, Germany (14.63per cent), Russian Federation has lost its share to Netherland (28.39 per cent),16.57 per cent to Thailand, Netherland lost its share to Bangladesh is about 18.22per cent, Bangladesh has lost its share to Netherland (26.85per cent) and other (20.14per cent). The major benefit receiver from the Imports of Indian fresh grapes over the reference period was UAE, it had transfer probability of 100per cent from Srilanka, 33per cent from Germany from UK 25.86per cent and other 14.22per cents. Netherland had transfer probability from Russian Federation (28.39per cent), Bangladesh (26.85per cent), Germany (51.40per cent), and Belgium (62.86per cent). Russian Federation had transfer probability from Thailand (84.26per cent) and others (10.15per cent). Bangladesh had transfer probability from Netherland (8.25per cent) and Belgium (28.97per cent). Germany has transformed from the UK (14.63per cent) Reason for the high stability is because of consumer preferences taste and flavor and the low stability might be because of a lot of pesticide spray. K Nithin 2016 observed that Netherland was the most stable market among the major importers of Indian grapes as shown by the probability of retention at 80.56 per cent.

Results of table 5 showed that orange, we can see that over the year Bangladesh has emerged as one of the most stable countries by reflecting its highest loyalty to the tune of 97.99 per cent followed by Nepal (71.89per cent), Cameroon is showing the lowest loyalty. Even though UAE, Oman, Saudi Arabia, USA, Thailand, Canada, and Germany have emerged as major export destinations but they have failed to gain loyalty. The major benefit gainer among importer of Indian fresh orange over the reference period was UAE from Germany, Cameroon from Thailand, Nepal from UAE, and Bangladesh from Other countries 100 per cent. UAE and Oman showed the highest loss to Nepal which is about 100per cent followed by Thailand and Germany lost its100per cent share to Cameroon and UAE respectively. High loyalty is because of the good flavor and taste of Indian orange. Low loyalty because of competitiveness and a fall in the demand.

Table 6 revealed that in the case of apple, we come across Nepal as the highest/most stable country. This is reflected by its loyalty which is about 100per cent and other countries also show 100 per cent loyalty in importing Indian fresh apples. 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 100per cent from Congo and other countries have gained 100 cents from Saudi Arabia,

the USA, Srilanka, and China. Among the countries 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 share to Nepal (28.55per cent), Germany has lost to Nepal (95.65per cent) and Kuwait has lost Nepal (10.40per cent). High stability because of its being near to India and low stability is due to increasing demand and production being less it is restricted to only a few parts of India.

Conclusion

Since the cost of production is escalating in developed countries, they would like to shift their production to countries like India. To encourage this, India has to invite 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 and forward to increase exports. This will augment farmers' income and helps in employment generation. A country like Chile has largely benefited from multi-brand retail in their exports of wine and fruits across the globe. Multinational retailing will enable Indian fruit growers to access the global market as efficient producers, this would help to establish producer-seller linkages in the world market which would be more remunerative to Indian 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.

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

Chengappa PG. The 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.

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

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

Rabha L, Sarma RK. Growth and Export Potential of Horticultural Crops from India: An Overview. *Econ Aff*. 2021; 1:66(2):253-8.

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

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

Surendra BK, Daya S, Tushar P. Export Performance of Fresh Mangoes from India. *Econ Aff*. 2021; 1:66(2):201-5.

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.

Table 1: Destination -wise growth rates in the 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 5per cent 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	The 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	China	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**