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Markov chain analysis on the export prospectus of Banana in India

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Abstract

The study was carried out to analyze the export prospects of banana in India by using the markov chain model. The secondary data on export quantity of banana in India from the period 1990-91 to 2017-18 (28 years) were obtained from website of Directorate General of Commerce, Industries and Statistics, Kolkata. The analysis revealed that UAE and Maldives were found most stable markets among the major importer studied for Indian banana. However, the countries like Nepal, Oman and other countries are as moderately stable. The maximum gainer among importers of Indian banana was Iran and it has gained from Nepal, Saudi Arab, Oman, Kuwait, Qatar, Maldives and other countries. The exported quantity of Indian banana has shown an increase of 255.21 percent with increased value by 568.70 percent over the base year during last 10 years studied.

Keywords: Stability, markov chain, banana and export

Introduction

Banana is the second most important fruit crop in India next to mango. Its year round availability, affordability, varietal range, taste, nutritive and medicinal value makes it the favorite fruit among all classes of people. According to the National Horticulture Board 2018, area under banana cultivation was 884 thousand ha with a total production 30808 thousand metric tons in India during the year 2017-18 (NHB, 2018). Besides India, other major banana producing countries are China, Philippines, Ecuador, Brazil and Indonesia. India produces a whopping total of 23 percent of the entire world production of banana. Because of its abundant production, it is predicted that the potential of export seems to be attractive. The leading states in production of banana in the country are Tamil Nadu, Gujarat, Maharashtra, Andhra Pradesh, Uttar Pradesh and Karnataka, while importers of Indian bananas are the UAE, Saudi Arabia, Oman, Bahrain and Nepal. India while being the largest producer of Banana at about 28 percent of world production, does not account as one of the banana trading nations because major production is utilized for domestic consumption. The global demand for banana is an opportunity for India to increase its export and there is huge potential in this area. Therefore, an attempt has been made in this study to analyze the direction of trade and future prospectus of banana trade in India.

Materials and Methods

Source of data

The secondary data on export quantity and its value of banana in India from the period 1990-91 to 2017-18 (28 years) were obtained from website of Directorate General of Commerce, Industries and Statistics, Kolkata and publications of Indian Horticulture Database also used for obtaining relevant data.

Statistical Analysis

Markov Chain Model

The structural change in the share of export of banana was examined by estimating the transition probability using markov chain model. The data on export of banana from India to different countries from 1990-91 to 2017-18 were taken for markov chain analysis. It is the stochastic process. The finite number of possible outcomes S_i ($i = 1, 2, \dots, r$) which is a discrete random variable X_t ($t = 1, 2, \dots, t$) and which assumes that the probability of an outcome on the t^{th} trial depends only on outcome of the preceding trial and this probability is constant for all time periods. P is the estimation of transition probability matrix, P_{ij} is the probability that exports will switch over from country i to country j with passage of time and the diagonal

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element of P_{ij} measures the probability that the export share of a country will be retained. In this study, the average exports to a particular country was considered to be a random variable which depends only on its past exports to that country and which can be denoted as.

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

Where,

E_{jt} is the exports from India during the year t to j^{th} country

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

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

E_{jt} error term which is statistically independent of E_{ij-1}

R is the number of importing countries

The transition probability matrix (c x r) satisfying the following properties

$$0 \leq P_{ij} \leq 1 \sum_{i=1}^r P_{ij} = 1 \text{ for all } i$$

Results and Discussion

The percent of banana exported quantity and value from India exhibited fluctuating trend over the period from 2009-10 to 2017-18 at the base year 2008-09 (Table 1 and 2). The exported quantity of Indian banana has shown an increase of 255.21 percent and export value of banana has been increased by 568.70 percent over the base year during period of last ten years.

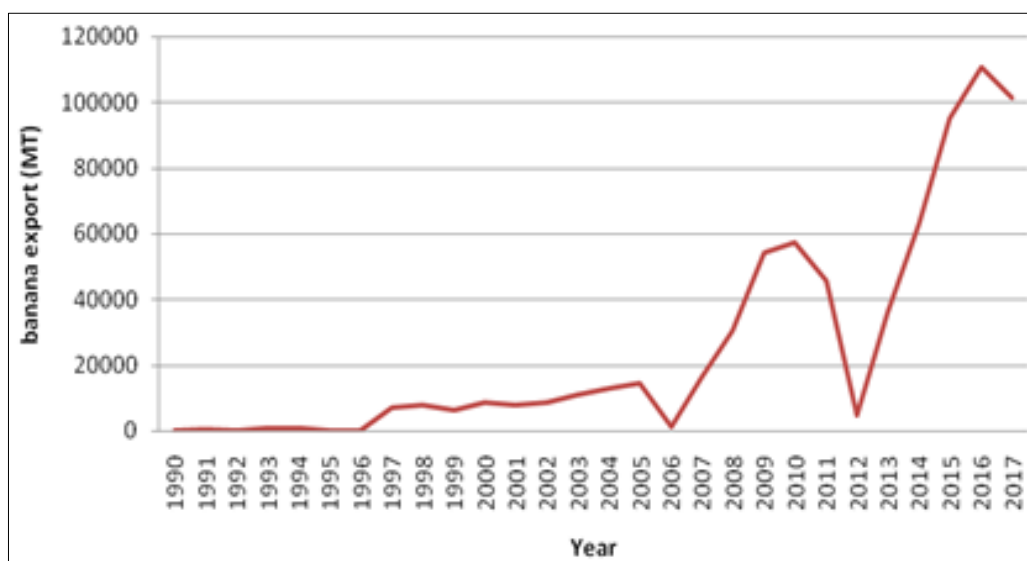


Fig 1: Annual export of banana from India during 1990-91 to 2017-18

The transition probability matrix presented in Table 3, it provides a broad indication of changes in the direction of export of banana from India for the study period (1990-91 to 2017-18).

Trade matrix for export of banana from India was estimated using markov chain approach in order to identify relationship that exists among importing countries and presented in Table 10. The major Indian banana importing countries were UAE, Nepal, Saudi Arab, Iran, Oman, Kuwait, Bahrain, Qatar and Maldives. It is evident that UAE was one of the most stable market among the major importers of Indian banana as reflected by the probability of retention at 0.80 that is probability that UAE retains its exports share over study period was 80.00 percent. Similar results were reported by Kusuma *et al.* (2014) [3] for mango export, Prabakar (2020) [7] for coconut export and Mohammadullah *et al.* (2021) [5] for grape export from India. Banana export to UAE was retain to the tune of 80 percent of its previous years share in the current period of the remaining 20.00 percent of UAE market share 10.00 percent was directed to Nepal and 10.00 percent to Saudi Arab. Thus, UAE was the most reliable and loyal market for banana. A high probability of retention of Maldives (0.56%) implied that it had lost 44 percent of its share to other importing countries. Out of its remaining 44 percent share 11.00 percent to each was directed to four countries viz. Iran, Bahrain, Qatar and other countries. Also

high probability of retention was observed in Nepal that is 0.50 which means its retain its export share of 50.00 percent. Moderate probability of retention was found in Oman and remaining countries such as Kuwait, Bahrain and Qatar had the retention of 20.00 percent each of its original share. Similar results were reported by Patil *et al.* (2018) [6] and observed that Bangladesh was most stable importer of Indian mango followed by UAE, Baharain and other countries respectively. Bhagat *et al.* (2022) [1] observed that Bangladesh and Malaysia were most stable markets for Indian onion export. Joshi *et al.* (2015) [4] for Indian spices exports from India. Bangladesh lost 30 percent market share to Malaysia while Malaysia lost 20 percent market share to Bangladesh and remaining 10 percent share to Sri Lanka. Moderate stability shown by the countries like Nepal, UAE and Oman having 55.60, 50.00 and 50.00 percent retention probability respectively.

The major gainers among importer of Indian banana over a period of time have been Saudi Arab and Iran. Saudi Arab has a transfer probability of 0.22 from others countries, 0.20 from Nepal, 0.18 from Iran and 0.10 from UAE. The probability that Iran would gain in the export share of Indian banana over the study period at the cost of Qatar, Nepal, Saudi Arab and Maldives were 0.20, 0.20, 0.20 and 0.10 respectively. Therefore Saudi Arab and Iran loses cent percent of its total imports.

Table 1: Export quantity (MT) for banana in different countries over the year.

Years	UAE	Nepal	Saudi Arab	Iran	Oman	Kuwait	Bahrain	Qatar	Maldives	Others	Total	% share of top 9 countries	% share of other countries	% increase over base year
2008-09	10208	7855	5123	23	947	1533	1263	1347	1242	855	30396	97.19	2.81	
2009-10	18644	6559	9416	5204	1977	5552	2890	2684	648	730	55034	98.67	1.33	81.06
2010-11	11674	5929	8954	9352	1537	5474	10965	1802	981	862	58392	98.52	1.48	92.10
2011-12	15134	9766	5014	4126	2228	3196	2437	2053	913	694	46255	98.50	1.50	52.17
2012-13	14802	11206	4403	790	3925	2220	2566	2809	645	6624	49990	86.75	13.25	64.46
2013-14	14000	5933	4809	943	3521	2149	2074	1934	310	435	36543	98.81	1.19	20.22
2014-15	19011	8638	9314	3378	4926	4684	1802	3211	664	7646	70920	89.22	10.78	133.32
2015-16	24971	15573	12677	20305	8486	4974	1940	2947	1273	527	94200	99.44	0.56	209.91
2016-17	24277	27583	10263	15710	12929	10442	2606	3747	1503	1689	112438	98.50	1.50	269.91
2017-18	19073	20915	7918	14095	18159	6121	2068	4601	1707	6657	107971	93.83	6.17	255.21

Table 2: Export value (Rs. lakh) for banana in different countries over the year.

Years	UAE	Nepal	Saudi Arab	Iran	Oman	Kuwait	Bahrain	Qatar	Maldives	Others	Total	% share of top 9 countries	% share of other countries	% increase over base year
2008-09	2476	304	1090	3	225	384	446	318	140	160	5546	97.12	2.88	
2009-10	4744	347	2427	1167	526	1616	1071	843	105	175	13196	98.67	1.33	137.94
2010-11	2774	332	2140	1958	347	1213	656	450	136	223	10452	97.87	2.13	88.46
2011-12	3794	514	1246	951	485	718	584	493	178	188	9339	97.99	2.01	68.39
2012-13	5354	935	1516	208	1056	701	793	906	142	1449	14509	90.01	9.99	161.61
2013-14	6769	1006	2505	322	1516	1229	973	1024	147	192	15875	98.79	1.21	186.24
2014-15	8755	955	4558	1247	2004	2242	953	1672	207	1603	25799	93.79	6.21	365.18
2015-16	11729	1793	6318	6763	3200	2470	1054	1781	451	209	35977	99.42	0.58	548.70
2016-17	11863	2708	5190	5461	4616	4299	1305	2242	466	611	39372	98.45	1.55	609.92
2017-18	9150	1981	3815	4939	6283	2654	927	2318	601	2209	37086	94.04	5.96	568.70

Table 3: Markov chain analysis of banana export quantity from India to different countries (2008-09 to 2017-18).

Countries	UAE	Nepal	Saudi Arab	Iran	Oman	Kuwait	Bahrain	Qatar	Maldives	Others
UAE	0.80	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nepal	0.00	0.50	0.20	0.20	0.00	0.10	0.00	0.00	0.00	0.00
Saudi Arab	0.00	0.20	0.00	0.20	0.20	0.10	0.20	0.00	0.00	0.10
Iran	0.09	0.10	0.18	0.00	0.18	0.00	0.00	0.27	0.09	0.09
Oman	0.00	0.00	0.00	0.10	0.30	0.30	0.10	0.10	0.00	0.10
Kuwait	0.00	0.00	0.30	0.10	0.20	0.20	0.10	0.00	0.10	0.00
Bahrain	0.00	0.10	0.00	0.00	0.00	0.20	0.20	0.30	0.10	0.10
Qatar	0.00	0.00	0.00	0.30	0.10	0.10	0.20	0.20	0.00	0.10
Maldives	0.00	0.00	0.00	0.11	0.00	0.00	0.11	0.11	0.56	0.11
Others	0.00	0.00	0.22	0.11	0.00	0.00	0.11	0.00	0.23	0.33

Conclusions

1. UAE and Maldives were found most stable markets among the major importer studied for Indian banana. However, the countries like Nepal, Oman and other countries are as moderately stable.
2. The maximum gainer among importers of Indian banana was Iran and it has gained from Nepal, Saudi Arab, Oman, Kuwait, Qatar, Maldives and other countries.
3. The exported quantity of Indian banana has shown an increase of 255.21 percent with increased value by 568.70 percent over the base year during last 10 years studied.

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