

Research Article QUANTIFICATION OF CHANGING STRUCTURE OF INDIAN MANGO EXPORTS USING MARKOV CHAIN ANALYSIS

SHARMA MOHIT1*, SHARMA RAJESH2 AND MATHUR ADITI3

^{1.3}Institute of Agribusiness Management, SK Rajasthan Agricultural University, Bikaner, 334006, Rajasthan
²Department of Agril Economics, SK Rajasthan Agricultural University, Bikaner, 334006, Rajasthan
*Corresponding Author: Email-mohitsh.iabm@gmail.com

Received: December 04, 2016; Revised: December 08, 2016; Accepted: December 09, 2016; Published: December 12, 2016

Abstract- The India occupies top position among mango growing countries of world and produces 46 per cent of the total world mango production. India is having number of export destinations i.e. more than 50 countries but exported quantity is very low, production to export ratio is less than 1. This study is an attempt to understand change of direction of trade of Indian mangoes overseas and drawing their projections to major importing countries. Data for analysis was taken for a period of 15 years from 2000 to 2015. The Markov chain analysis was attempted to assess the transition probabilities for the major mango markets. Major mango markets were categorized as stable markets (Bangladesh, UAE, Nepal) and unstable markets (USA, UK, Saudi Arabia). There is need for improving the efficiency of production and quality in order to stabilize the markets specially the ones, which are conscious towards quality and ready to pay higher prices.

Keywords- Indian mangoes, Transitional probabilities, Export, International market, Production, Quality

Citation: Sharma Mohit, et al., (2016) Quantification of Changing Structure of Indian Mango Exports Using Markov Chain Analysis. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 60, pp.-3381-3384.

Copyright: Copyright©2016 Sharma Mohit, et al., This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Academic Editor / Reviewer: Dr Piyush Mehta

Introduction

India is the fruit and vegetable basket of the world. It is the home of wide variety of fruits and vegetables and holds a good position in the production [1]. India hosts a rich diversity in mango varieties, each with its unique taste, flavor, texture and the size. Mango, theking of fruits, has a great export potential due to exquisite taste and flavor [2]. India ranks first in area and production of mango with 2.51 million ha and 184.31 lakh tonnes, respectively, accounting to about 46 percent share of world's total production [3]. In India, about 1,500 varieties of mango are grown including 1,000 commercial varieties. Each of the main varieties like alphonsho, *neelum, mallikaarjun* etc. has a unique taste and flavor. Mango varieties having good demand in international market are alphonsho, *kesar, banganapalli, dasheri* etc. This remarkably marks great potential for other Indian varieties to explore in the international market. Keeping in view the same, the export figures are not healthy, like we are exporting only 41.2 K tonnes of quantity to major export destinations such as UAE, UK, Saudi Arabia and Kuwait etc. It indicates that production to export share is only 0.22 % [4].

In order to have suggestive approaches for the promotion of export from the country, there is a need from government, private (exporters, associations) to support producers, formulate channel for successful implementation of GAP, to focus at international level [5]. Therefore, an attempt has been made to quantify the changing structure of Indian mango exports. The main objective of the paper was to study the direction of export and structural change in mango exports.

Materials and Methods

Annual mango export data for period 2000 to 2015 obtained from APEDA were used to analyze the direction of trade and changing pattern of Indian mango exports. The major Indian mango importing countries considered were UAE, USA, UK, Bangladesh, Saudi Arabia, Nepal and rest others. Markov chain analysis

method was employed to examine the exports for study period of 15 years. As per Dent, 1967, [6] this method is very useful for analyzing the structural change in any system, say here Indian mango exports.

In the present study, the dynamic nature of trade patterns that is the gains and losses in export of Indian mango in major importing countries was examined using the Markov Chain Model. Markov Chain Analysis involves developing a transitional probability matrix 'P', whose elements, P_{ij} indicate the probability of exports switching from country 'i' to country 'j' over time. The diagonal element P_{ij} where i=j, measures the probability of a country retaining its market share means quantity of exports, let's say e.g. at present UAE is the biggest market for Indian exports so it can be assessed whether or not it will continue trade in similar extent from India. In the context of current application, structural change was treated as a random process with seven importing countries for mango the assumption will be that the average export of mango from India amongst importing countries in any period depends only on the export in the previous period and this dependence will be same among all the periods. This will be algebraically expressed as:

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

Where, Ejt = exports from India to the jth country in the year t

E_{it-1} = exports of ith country during the year t-1

P_{ij} = the probability that exports will shift from ith country to jth country

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

n = the number of importing countries

The transitional probabilities Pij, which can be arranged in a (c x n) matrix, have the following properties.

Quantification of Changing Structure of Indian Mango Exports Using Markov Chain Analysis

$$\sum_{i=1}^{n} P_{ij} = 1$$

Thus, the expected export share of each country during period 't' is obtained by multiplying the exports to these countries in the previous period (t-1) with the transitional probability matrix.

The probability matrix was estimated for the period 2000-01 to 2014-15.

Thus transitional probability matrix (T) was estimated using linear programming (LP) framework by a method referred to as minimization of Mean Absolute Deviation (MAD).

Min, OP* + I e Subject to

GP* = 1 P* >0 Where,

P* is a vector of the probabilities P i j

O is the vector of zeros

i is an appropriately dimensional vectors of areas e is the vector of absolute errors

Y is the proportion of exports to each country. X is a block diagonal matrix of lagged values of Y

A is a block diagonal matrix of lagged va

V is the vector of errors

G is a grouping matrix to add the row elements of P arranged inP* to unity. Predictions of quantity of fresh mango export were made by using the Transitional Probability Matrix.

Where, B_0 =Quantity exported in Base years, B_{t+i} =quantity exported in next year (prediction)

T = Transitional probability matrix

Results and Discussion

Transitional probabilities of mango exports to different destinies from India are presented in [Table-1] depicting a broader idea of change of direction of trade over a period of 15 years.

By examining the trend for 15 years, six major Indian mango importing countries considered as UAE, USA, UK, Bangladesh, Nepal and Saudi Arabia. Exports to other countries were pooled under the 'Others'. The diagonal elements in a transitional probability matrix provide the information on the probability of retention of trade, while the row elements indicate the probability of loss in trade on account of competing countries. The column elements indicate the probability of gain in trade from other competing countries.

Country	······>										
	Lose										
	UAE	USA	UK	Bangladesh	Nepal	Saudi Arabia	Others	lain			
UAE	0.592	0	0.061	0.092	0.117	0.001	0.138				
USA	0	0	0	0	0	0	1				
UK	1	0	0	0	0	0	0				
Bangladesh	0.133	0	0.034	0.791	0	0.029	0.013				
Nepal	0.524	0	0	0	0.476	0	0				
Saudi Arabia	0.748	0	0	0	0	0	0.252				
Others	0.440	0.062	0	0	0	0.316	0.181	Ň			

Source: Autor's own computation from secondary data

a.

It can be observed from [Table-1] that Bangladesh, UAE and Nepal are comparatively stable markets among major importers of Indian mangoes as reflected by the higher probability of retention at 0.791, 0.592 and 0.476 respectively. That means the probability that Bangladesh retained its export share over the study period was 79 per cent similarly, UAE retained its exports by 59 per cent and Nepal is also fairly stable retaining its share up to 47 per cent.

UAE lost its 11 percent of import share to Bangladesh and 14 per cent to other countries. Further, it can be inference from the table that Bangladesh has lost its 14 per cent import share to UAE. Nepal and Saudi Arabia have also lost their import share from UAE in percent of 52 and 74 respectively. Other countries have

gained their share from Saudi Arabia and UAE i.e. 25 and 14 per cent respectively.

Projections of Indian mango exports to major importing countries

Using transitional probability matrix projected values for export have predicted up to year 2020. While actual and predicted values presented for various importing country has been calculated and presented graphically.

Trend for actual and predicted quantity of fresh mangoes export from India to selected importing countries (2000-2015)



Source: Author's own computation from secondary data

For USA: 10.000.00 9.000.00 8,000.00 tonnes 7,000.00 6,000.00 Ξ. 5,000.00 Quantity 4,000.00 Actual 3.000.00 Predicted 2.000.00 1.000.00 0.00 2000 2002 2004 2006 2008 2010 2012 2014 2016 Years

Source: Author's own computation from secondary data

International Journal of Agriculture Sciences ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 60, 2016



Source: Author's own computation from secondary data

d. For Bangladesh



e. For Nepal



Source: Author's own computation from secondary data

f. For Saudi Arabia:



Source: Author's own computation from secondary data

g. For other countries:



Source: Author's own computation from secondary data

As it could be evident from the table, the actual export share to UAE has increased from 18.48 to 54.98 per cent of total Indian exports from 2000 to 2015. However, projected share shows that exports to UAE would be around 50.78 per cent, which indicated downfall in export share. Recent warning by UAE government for increase in pesticide level can play role for deceasing export share, keeping in view at present UAE is the lead market for Indian mango exports. The proportions of actual mango export to Bangladesh have decreased to larger extent over the study period of 2000 to 2015. It has come down to less than 1 per cent in 2015 compared to 58 per cent in 2000. However, projections up to the year 2020 shows significant increase in the share of Bangladesh which is about 18 per cent. Major import markets for mangoes i.e. USA, UK are not considerably showing healthy export share in the projections up to 2020. Projections for Nepal have also shown decrement in the export share in the year 2020 as compared to the actual values for the year 2015.

Table-2 Percent share of Indian mango exports for actual values and predicted values (projections) to various destinies (%)														
Year	ar UAE		E USA UK		Bangladesh		Nepal		Saudi Arabia		Others			
	Α	Р	Α	Р	Α	Р	Α	Р	Α	Р	Α	Р	Α	Р
2000	18.48	31.26	1.93	0.86	2.27	3.09	57.74	47.37	0.03	2.18	5.69	6.07	13.85	9.17
2001	28.83	36.91	1.64	0.76	3.09	3.37	47.35	40.10	0.23	3.48	6.62	5.27	12.23	10.12
2002	36.93	41.84	1.23	1.04	3.23	3.45	35.24	31.27	1.12	4.85	5.49	6.35	16.76	11.20
2003	34.78	40.51	1.04	0.69	2.50	3.46	39.30	34.28	4.84	6.37	6.35	4.71	11.19	9.98
2004	19.33	31.48	0.07	0.42	2.45	3.25	60.78	49.85	6.36	5.29	4.30	3.90	6.72	5.82
2005	38.12	37.14	0.12	0.33	1.21	3.92	47.08	40.74	5.91	7.27	2.25	3.08	5.31	7.52
2006	27.88	34.28	0.00	0.22	2.38	3.54	54.25	45.46	10.19	8.11	1.67	2.75	3.62	5.63
2007	41.34	45.18	0.26	0.35	4.74	3.59	31.40	28.63	13.89	11.45	2.74	2.73	5.62	8.08
2008	29.36	34.76	0.24	0.32	3.02	3.62	53.89	45.32	5.69	6.14	2.56	3.25	5.24	6.59
2009	34.39	39.26	0.24	0.41	3.97	3.63	45.06	38.80	5.45	6.62	4.23	3.44	6.66	7.84
2010	43.28	42.17	0.17	0.42	4.62	3.97	39.15	34.94	3.38	6.67	2.69	3.29	6.70	8.54
2011	34.70	39.58	0.56	0.45	3.99	3.60	43.51	37.60	6.19	7.00	3.77	3.60	7.29	8.18
2012	67.65	56.08	0.43	0.66	5.95	4.41	8.37	12.84	4.03	9.83	3.00	3.65	10.58	12.54
2013	55.84	56.15	0.59	1.33	8.19	3.64	7.03	10.69	2.67	7.80	4.17	7.05	21.51	13.32
2014	67.99	54.94	0.63	0.71	0.77	4.34	5.76	10.80	8.31	11.91	5.05	3.86	11.49	13.43
2015	54.98	57.38	0.73	0.83	4.12	3.36	0.13	5.16	22.78	17.27	3.85	4.29	13.41	11.72
2016*		55.40	-	0.73	-	3.67		9.35	-	14.93	-	3.91		12.01
2017*		53.72	-	0.74	-	3.70		12.49	-	13.58	-	4.12	-	11.65
2018*		52.46		0.72		3.71		14.82	-	12.74	-	4.09		11.46
2019*		51.49		0.71		3.70		16.54		12.20		4.10		11.26
2020*		50.78		0.70		3.70		17.81		11.83		4.09		11.10

Source: Autor's own computation from secondary data

Note: A indicates actual values, while P indicates predicted values, years with * represents forecasted values (in percent)

Conclusion

India is the largest mango producer, despite being hundreds of commercial varieties its export share is very low. Present study also shows in predictions up to 2020 that there is not going to be very significant changes to the present mango export market. The requirement of other countries, maintaining good faith in market, keeping product quality throughout the value chain are very important factor for consideration and only then this export market can be strengthened. Various studies have indicated that with the adoption of Good Agricultural Practices good quality can be maintained and it has given growers the platform to fetch good prices in the international market. But there is need for both public as well as private side to build up a suitable structure so that world's largest producer for mangoes can maintain important share in the export market as well.

Acknowledgement: I am highly thankful to the contributors of this paper both the co-authors that they guided and encouraged me to undergone this research.

Author Contributions: This paper is the part of doctorate research of corresponding author on Indian mango export with Good Agricultural Practices, where an attempt has been made to assess various factors which are responsible for low growth of export market and further how this market can grow with responsible public, private model.

Abbreviations

APEDA- Agricultural and Processed Food Products Export Development Authority GAP- Good Agricultural Practices LP- linear programming MAD- Mean Absolute Deviation T- Transitional probability matrix UAE- United Arab Emirates UK- United Kingdom USA- United States of America

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors..

Conflict of Interest: None declared

References

- [1] Kusuma D.K. and Basavaraja H. (2014) Karnataka Journal of Agricultural Sciences, 27.1.
- [2] Gopalakrishnan Sarada (2013) World Applied Sciences Journal, 21.7, 1000-1007
- [3] nhb.gov.in/area-pro/NHB_Database_2015.pdf extracted on 26/05/2016
- [4] http://agriexchange.apeda.gov.in/Market%20Profile/MOA/Product/MANGO. pdf extracted on 23/09/2016.
- [5] Sharma M. and Mathur A. (2016) International journal of research in business management, 4(5), 35-44.
- [6] Dent W.T. (1967) Review of Economics and Statistics, 49(2), 613-616.