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EXPORT PERFORMANCE OF BANANA IN INDIA – A MARKOV CHAIN ANALYSIS

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Abstract

India is the 20th biggest exporter of banana globally and also consumes bananas in greater quantity. Banana is the fourth largest contributor in total export of fruits from India. In the present study Markov Chain Analysis was attempted to assess transitional probability matrix and steady state probability matrix. It was estimated that during the year 2009 to 2018, the identified major banana destinations were UAE, Saudi Arabia, Iraq and Nepal. It is evident that UAE had one of the most stable market among the major importers of Indian banana as reflected by higher probability of retention. The steady state probability showed that in future 45 per cent of Indian banana export would go to UAE and other 39.41 per cent would go to other banana importing countries.

Keywords: Banana, Markov chain analysis, Export, Destinations

Introduction

Banana (*Musa paradisica* L.) is an important domesticated herbaceous fruit crop of many tropical and subtropical regions in India. It is the oldest and commonest fruit known to the mankind. India is the 20th biggest exporter of bananas globally due to the fact that the country also consumes bananas in greater quantity. It is the fourth largest contributor in total export of fruits from India. It is a very popular fruit due to its low price and higher nutritive value. It is consumed in fresh or cooked form both as ripe and raw fruit. The advantage of this fruit is availability round the year makes it the favorite fruit among all classes of people. Banana and plantains are grown in about 120 countries in the world The major banana producing countries in the world include china, Ecuador, Philippines, Brazil, Indonesia, Guatemala, Angola and Burundi (NHB, 2018). Amongst fruits, India ranks first in production of bananas 25.7 per cent (APEDA). Major banana producing states are Andhra Pradesh, Tamil Nadu, Maharashtra, Gujarat, Kerala and Karnataka. Among which Maharashtra stood as the largest banana exporting state with 96.91 per cent share in value. The major destinations for Indian bananas are UAE, Saudi Arabia, Oman, Iran and Bahrain respectively. These countries have imported more than 50 per cent of India's banana during the period (APEDA, 2017). The paper attempts to analyze the growth rate of area, production and productivity of banana in India and to access the direction of trade of banana so as to understand the dynamics of the changes in the banana export.

Materials and Methods

The present study related to the area, production, productivity and export of banana were collected from NHB (National Horticulture Board) published sources and various published issues of APEDA (Agriculture Produce Development Authority).

Growth Rate Analysis

To study the growth rate in Area, Production and Productivity of banana in India, the compound growth rate was computed using the exponential growth model.

$$y=a\ b^t$$

$$\log y=\log a+ t \log b$$

$$Y=A + B\ t$$

Where,

Y=log y

A=log a

B=log b

Y = Area (ha)/ production (tonnes) and productivity (tonnes/ha)

t = Time elements which takes the value 1, 2…n for various years

A = Intercept

B = Regression co-efficient

Compound Growth Rate 'r'= (Antilog of B-1) × 100.

Student "t" test was used to test the significance of the calculated compound growth rate.

$$t=r/SE(r)$$

Where,

r = Compound growth rate

SE = Standard Error.

Markov Chain Analysis

In this study, the direction of trade and the changes in exports were examined by employing first order Markov chain model. There is growing awareness of the usefulness of this technique for analysis and forecasting in many fields including exports particularly in the case of variables in the process of constant but gradual change.

The share of trade of banana from India (X_{it}) to a particular market (j) at time 't' is considered as a random variable and this depends only on its past trade of the particular markets. In the context of current analysis, major importing markets of banana from India markets were

considered. The average trade to particular market was c considered to be a random variable following a first order Markov process.

The average trade to a particular market was considered to be a random variable which depends only on the past trade to that market, which can be denoted algebraically as

$$Xjt = \sum_{i=o}^{n=1} X_{it} - 1.P_{ij} + ejt$$

Where,

Xjt = is the trade of banana from India to j^{th} market during the year 't'

Xi t-1 = Trade of banana to i^{th} market during the year t-1.

Pij = is the probability of the trade which will shift from i^{th} market to j^{th} market

ejt = is the error term independent of Xit-1

n = is the number of importing markets in India

The transitional probability (Pij) is central to Markov chain model which can be arranged in a (c*r) matrix, has the following properties.

$$0<Pij<1$$

$$\sum Pij=1, \text{ for all 'i'}$$

The transitional probability Pij indicates the possibility that trade will switch over from the market 'i' to other market 'j' with the passage of time. The probabilities Pij for $i \neq j$ indicate the gain or losses in trade of each of the importing market. The probability Pij for i=j(diagonal probabilities) indicates probability of retention of an importing market.

Estimation of Markov chain model

There are several approaches to estimate the transitional probabilities of the Markov chain model such as un weighted restricted least squares, weighted restricted least squares, Bayesian, Maximum likelihood, unrestricted least squares etc. in the present study, minimum absolute deviations (MAD) estimation procedure was employed to estimate the transitional probabilities, which minimizes the sum of absolute deviations. The conventional linear programming (LP) 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, Min OP*+Ie

Subject to,

XP*+V=Y

GP*=1

P>0

Where,

0 is the vector of zeros

P* is the vector of probability Pij

I is an appropriately dimensioned identify matrix e is the vector of exports of absolute error

Y is the vector of exports of each country

X is the block diagonal matrix of lagged values of Y V is the vector of error

G is the grouping matrix to add row elements of P arranged in P* to unit

To analyze the actual shares of each market to different markets of banana, percentage analysis have been used.

Results and Discussions

Banana contributes to 37 per cent of total fruit production in India and it is also the highly consumed fruit cultivated in India. The important banana producing states in India are Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh and Karnataka. State wise area, production and productivity of banana during 2017-18 are presented in Table 1. It is cultivated in an area of about 860 thousand hectares with a production of about 30807.50 MT in India. The national average productivity was 34.86 MT production it stood first in productivity.

It could be seen from table 2 the area under banana cultivation in India has increased from 533 thousand ha in 2007-08 to 860 thousand ha in 2016-17. While in production of banana increased from 17647 thousand tones in 2007-08 to 30477 thousand tones. Banana productivity is also increased from 33.1 tones per ha in 2007-08 to 34.8 tones per ha in 2016-17. The compound growth rate of area, production and productivity of banana observed that a high positive and significant growth was in area and production (Mehazabeen *et al.,* 2019).

The direction of trade of Indian banana to different importing countries were studied by estimating the transitional probability matrix and steady state probability matrix using the Markov chain analysis. This matrix explained the changing direction of Indian fresh onion trade among importing countries which was necessary for taking the proper decision in view of their expected changes (Kumar *et al.,* 2007).

The transitional probabilities and steady state probabilities were presented in Table 3. It represents a broader idea of change of the direction of trade over a period of ten years. There were six countries, which imported India banana *viz.,* UAE, Oman, Saudi Arabia, Iran and Nepal. From the table 1 it is evident that 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 per cent.

Thus, UAE was the most loyal and reliable market of Indian banana. Saudi Arabia had probability retention of 0.0485, which retains its export share of 4.8 per cent. This implies that it had lost most of its share to another importing countries. The countries such as Oman, Iran and Nepal had the retention of 4.44 per cent, 1.18 per cent and 2.82 per cent respectively. The other importing countries had retention of share of 54.67 per cent. This implies that the exporters of India could explore newer possibilities with countries categories under 'others' also. However Oman gained 49.73 per cent of Nepal, 42.72 per cent of Iran and 4.04 per cent of other countries market share. Iran gained 13.06 per cent of Saudi Arabia, 10.93 per cent of Oman, 13.06 per cent of Nepal and 3.44 per cent of other countries market share.

The steady state probabilities showed that, in future 45 per cent of Indian banana export would go to UAE, 39 per cent would go to Oman, 3.65 per cent would go to Saudi Arabia, 6.37 per cent to Iran, 1.44 per cent to Nepal and 39.41 per cent would go to other banana importing countries.

Table 1 : State-wise area, production and productivity of banana in India (2017-18)

S. No.	State	Area (000'ha)	Production (000' mt)	Productivity (ha/mt)
1	Andhra Pradesh	88.96	5003.07	56.24
2	Gujarat	68.15	4472.32	65.63
3	Maharashtra	80.88	4209.27	52.05
4	Karnataka	110.55	2328.90	21.07
5	Kerala	109.26	1119.16	10.24
6	Tamil Nadu	82.63	3205.04	38.79
7	Uttar Pradesh	69.38	3172.33	45.73
8	Madhya Pradesh	26.35	1834.03	69.54
9	West Bengal	49.30	1200.00	24.34
10	Bihar	31.07	1396.39	44.94
	Others	140.78	3787.75	12.60
	Total	883.8	30807.50	34.86

Table 2 : Area, production, productivity of Banana in India

Year	Area (000'ha)	Production (000' mt)	Productivity (ha/mt)
2007-08	53.30	23823.0	36.2
2008-09	709.0	26217.0	37.0
2009-10	770.3	26469.5	34.4
2010-11	830.3	29780.0	35.9
2011-12	796.5	28455.1	35.7
2012-13	776.0	26509.1	34.2
2013-14	802.6	29724.6	37.0
2014-15	821.8	29221.4	35.5
2015-16	841.2	29134.8	34.6
2016-17	860.0	30477.2	35.4
CGR	**3.45**	**4.28**	**0.10**

Table 3 : Transitional Probabilities and Steady State Probabilities of Direction of Indian Banana Trade

Countries	UAE	Oman	Saudi Arabia	Iran	Nepal	Others
UAE	**0.549651**	0.036262	0.038927	0.085006	0.018545	0.271609
Oman	0.648073	**0.044243**	0.042149	0.109377	0.023753	0.132404
Saudi Arabia	0.641355	0.049783	**0.048547**	0.130664	0.028239	0.101413
Iran	0.198807	0.42726	0.026881	**0.011873**	0.004278	0.715435
Nepal	0.641355	0.49783	0.048547	0.130664	**0.028239**	0.101413
Others	0.336403	0.040465	0.033231	0.034471	0.008675	**0.546756**
Steady state probability	0.451782	0.39333	0.036531	0.063712	0.14444	0.394197

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