Growth and Export Performance of Mango in India

Abstract

India is one of the world's leading mango producers, generating more than half of the global supply. Mango exports from India in the year 2021-22 was 27,872.77 MT. Mangoes are accessible all year as fresh fruit and processed goods. However, in recent years India's export was failed to meet the international food safety requirements due to Sanitary and Phyto-sanitary problems. Hence, this study focussed on estimating the growth from 1991 to 2020 and the direction of mango exports from 2011 to 2020 from India. The time series data of mango area, production, productivity and export in quantity and value were collected from various publications like APEDA, Horticulture statistics at a glance. Over the entire period, production was significant at the one per cent level and the productivity of mangoes was increased. This study found that the export quantity and its value increased significantly and positively. But quantity was not equal in proportion to the growth rate of export in terms of value. The transition probability matrix revealed that UAE (United Arab Emirates) and Nepal were the stable markets for Indian mangoes, with trade retention of 59 and 22 per cent, respectively. This study suggested that developing norms for producing safe mangoes as knowledge advances would make it easier to grant, maintain and move forward with Good Agricultural Practices (GAPs).

Keywords: Mango, Area, Production, Productivity, Growth rate, Export, Markov chain

1.Introduction

Mango is one of the Asia's most important and well-known fruits. There are approximately 4000 mango varieties known worldwide, but only a few are commercially important. Mangoes are eaten both fresh and cooked. India, China, Thailand, Pakistan, Mexico, Indonesia and Brazil are all major mango producers. Alphonso, Totapuri, Banganapalli, and Kesar are the most exported mango varieties from India. India's major

mango production states are Andhra Pradesh, Uttar Pradesh, Karnataka, Bihar, Gujarat, Maharastra, Tamil Nadu, West Bengal, Kerala, and Orissa. The area under mango was 1077.6 thousand hectares during 1991-1992, then it increased to 2317.00 thousand hectares in 2020-21. In the same way, mango production has also shown an increasing trend. Mango production was 15026.7 thousand MT in 2009-10 increased to 20386.00 thousand MT in 2020-21 (Horticulture Statistics Division, DAC&FW, 2021). India's export on fresh mango are rising in volume and value. The country has exported 21033.58 MT of fresh mangoes to the world worth Rs. 406.45 crores/ 60.26 USD Millions during the year 2020-21 (APEDA, 2020). Major export destinations are United Arabian Emirates, UK, Oman, Qatar and USA. The fresh mangoes are exported under the H.S. code 08045020. Mango demand is steadily expanding on the global market. But, in the recent years India's export share was negligible due to poor agricultural, post-harvesting practices and the presence of pesticide residues on mango and its products. After fruit fly was identified in the produce, the United States prohibited the import of Indian mangoes in 1989 and the European Union followed suit in 1990. Sanitary and Phytosanitary (SPS) difficulties have always been significant in global trade and they have now emerged as one of the most significant potential Technical Barriers to Trade (TBT). Food safety is one of the most critical prerequisites for future trading with wealthy countries. So, it is necessary adhere to the Good Agricultural Practices (GAPs). Good Agricultural Practices (GAPs) and Global Good Agricultural Practices (GLOBALGAPs) could be used to meet quality criteria and these practices became popular among mango exporters (Waghmod et al.,2020). GAPs principles can be used to produce high-quality, safe fruits in a sustainable manner throughout preharvest and postharvest activities. As a result, using GAPs during on-farm production and post-production processes, as well as selling goods directly to consumers, will help farmers to earn higher prices for their produce while still providing quality fruits to customers (Maneesh et al., 2019).

The steady growth in mango area, production, productivity, and exports from India showed that India has considerable potential to grow more mango and become a significant exporter. There is an excellent opportunity to expand mango output, export and increase productivity. India's mango can compete well in the global market. Increased mango exports can be justified because they do not jeopardize domestic food security. With these issues, the present study has taken the following objectives to examine the export performance of mango in India.

2. Objectives:

To estimate the trend in the area, production, productivity and export of Mango in India

To analyze the direction of trade among the export of mango from India

3. Methodology:

3.1 Sources of Data

For the period 1991-92 to 2020-21, the study used time series data on area, production, productivity, and exports of mango from India gathered from several published issues of APEDA, Horticultural statistics at a glance and other official publications.

3.2 Tools of Analysis

The information was tallied and processed in preparation for analysis. Suitable econometric models were used to investigate the data, interpret the results and draw key conclusions pertinent to the study. The research's analytical procedures are described in detail below.

3.2.1 Compound Growth Rate

The compound growth rate was constructed to determine the area, production, productivity and export quantity trend for fresh mangoes of India using time series data for the period 1991-2020. The formula was as follows **(**Angles *et al*., 2011):

$$\mathbf{Y_t = a\, b^t\, U_t}$$

Where, Y_t=Dependent variable for which growth rate will be estimated (Mango area, production, yield, export quantity and value in year 't');

a=Intercept;

b=Regression coefficient;

t= time period from the year 1991-2020

U_t=Disturbance term in year 't;

The equation is transformed into log-linear form and written as,

$$\log Y_t = \log a + t \log b + \log U_t$$

3.2.2 Markov Chain Analysis

The Markov chain model investigated the structural shift in mango exports. The

transitional probability matrix "P" is crucial to the Markov model's success. The variables P_{ij} of this matrix represent the likelihood that mango exports will shift from a country "i" to "j" over time. The diagonal element P_{ij}, where i = j, represents the chance of a country's market share being constant. In other words, examining the diagonal elements of the transitional probability matrix reveals an importing country's commitment to a specific country's exports. According to Dent (1967), structural change was handled as a random process in the current application, with five importing countries for fresh mango considered: U.A.E., the United Kingdom, Saudi Arabia, Nepal, and Bahrain.

The data for the analysis of fresh mango exports included the years 2011 to 2020. Different factors, such as competition from other countries, quality and so on, influenced the percentage change yearly. The following calculations were used to calculate the export performance of mango.

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

Where,

E_{jt}=Exports of mango from India during the year"t" to j^{th} country,

E_{it-1}=Exports to i^{th}country during the year "t-1",

P_{ij} =The probability that mango exports will shift from i^{th} country to j^{th} country,

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

r = The number of importing countries.

The transition probabilities of Pij, which can be arranged in a (c x r) matrix, are as follows:

$0 \leq P_{ij} \leq 1$

$\sum_{i=1}^{n} P_{ij} = 1$ for all "i"s

Thus, the expected export shares of each country during period t were calculated by multiplying the preceding period's exports (t–1) by the transitional probability matrix "P".

A method known as minimization of Mean Absolute Deviation (MAD) was used to estimate the transitional probability matrix in the linear programming (LP) framework. The LP formula is as follows:

Min O"P* +Ie

Subject to

X P* + v = y GP* = I

P* ≥ 0

where, P* is a vector of the probabilities P_{ij}, 0 is a vector of zero, I is an appropriately dimensioned vector of country,

e is the vector of absolute errors (|U|),

y is the vector of exports to each country,

x is a block diagonal matrix of lagged values of y and v is the vector of errors and

G is a grouping matrix to add the row elements of P arranged in P* to unity.

4. Results and Discussion

4.1 Growth performance of Mango in India

A compound annual growth trend was fitted to examine the growth trend in area, production and productivity for fresh mango. To examine the trend in the area, production, and yield for the complete period of 1991 to 2020 used for the calculation, it was discovered that all variables such as area, production, and productivity showed an increasing tendency for the fresh mango. During the whole period of study, 1991 to 2020, the compound annual growth rate as can be seen in Table 1 for mango area was 2.86 per cent per annum, whereas production was expanding at a compound growth rate of 3.22 per cent per annum likewise productivity of mango increased by 0.33 per cent per annum Over the entire period; these were significant at one per cent level. Due to Good Agricultural Practices, especially high-density planting in mango have shown minimal growth in recent years on area, production and productivity. The high density planting technique for mango has recently gained popularity around the world. Due to the advantages of a greater population per unit area, early income, and lower maintenance costs compared to the conventional method of

cultivation (Oosthuyse, 2009; Ram et al., 2001) . Results of this analysis suggested that India's mango-growing region has risen due to which the returns from mango production were made possible new cultivars were adopted. Thus, improvements and techniques like High Yielding Variety and demonstration will enhance the productivity of mango (Patil et al., 2018). Fig 1 shows the trend in the area, production and productivity of Mango in India for the period 1991 – 2020

Table 1. Growth performance of mango in India during 1991-2020

Particulars	**CAGR**
Area	2.86
Production	3.22
Productivity	0.33

Source: Author's calculation based on data from Horticulture statistics at a glance (1991-2020)

Fig. 1 Trend in Area, Production and Productivity of Mango in India

4.2 Export performance of mango in India

The research found that the export quantity and value increased significantly and positively. Table 2 shows the growth rates for fresh mango exports in terms of quantity and value. In terms of mango export value, the highest growth rate was 9.29 per cent, which was notable at the one per cent level. The export growth rate in quantity also found positive at

2.09 per cent, which was significant at 1 per cent. But it was not equal to the growth rate of export in terms of value. The value of Indian mangoes was positive growth in importing countries. However, pesticide residue and fruit fly infestation, Indian mangoes have been banned in the US, European, and Japanese markets (Jha et al. 2016; Goyal et al. 2017). Fig. 2 shows the export trend in both terms of quantity and value.

Table 2. Export performance of mango in India during 1991-2020

Particulars	**CAGR**
Quantity	**2.09**
Value	**9.29**

Source: Author's calculation based on data from APEDA (1991-2020)

Fig.2 Trend in Mango Export quantity and value

4.3 Mango export transition probability matrix

It was reasonable to analyse the flow of Indian mango trade to various importing country by estimating the transitional probability matrix inside the Markov chain framework, it was possible to study the direction of trade of Indian mango to various importing countries. It demonstrates the commitment of an importing nation to a specific nation's exports. Annual mango export data from APEDA for the years 2011 to 2020 were utilized to examine trade

trends and changes in the export pattern of Indian mangoes. UAE, UK, Saudi Arabia, Nepal and Bahrain were major importing countries. The remaining significant imported countries were categorized as others. The exports during the 10 years study period were examined using the Markov chain analysis method. A general overview of the change in trade direction over ten years by presenting the transitional probability of Indian mango exports to various destinations is given in Table 3.

Table 3. Transitional Probability Matrix for Indian fresh mango exports from 2011 to 2020

Countries	UAE	SA	UK	Nepal	Bahrain	Others
UAE	0.59	0.07	0.00	0.19	0.03	0.12
SA	0.00	0.11	0.00	0.00	0.00	0.89
UK	0.00	0.00	0.10	0.00	0.00	0.90
Nepal	0.16	0.00	0.37	0.22	0.03	0.21
Bahrain	0.00	0.05	0.00	0.95	0.00	0.00
Others	0.82	0.00	0.06	0.00	0.00	0.12

Note: S.A – Saudi Arabia, UAE – United Arab Emirates, UK- the United Kingdom

Source: Author's calculation based on data from APEDA (2011-2020)

In a transitional probability matrix, the row elements represent the trade loss due to competitive countries, while the diagonal elements represent the trade retention. The column element shows the gaining of the trade from other competitive countries. From the above table, it can be seen that the UAE was the most consistent importer of Indian mangoes, keeping 59 per cent of its retention share from the previous year while losing 19 per cent to Nepal, 13 per cent to other significant importers and 7 per cent to Saudi Arabia even though it gained a substantiate share from others (i.e., 82 per cent).

Another consistent importer of Indian mangoes was Nepal, which kept 22 per cent of its market retention from the previous year while losing 37 per cent to the UK, 21 per cent to other countries and 16 per cent to the UAE. However, it increased its share from Bahrain and UAE by 95 per cent and 19 per cent respectively. Bahrain does not retain its previous year's share over a period; by losing 95 per cent share to Nepal and 5 per cent to Saudi Arabia. On the other hand it gained 3 per cent from Nepal and UAE. Other countries retained 12 per cent of their share, losing 82 per cent to the UAE while gaining 90 per cent from the UK. Saudi Arabia and the UK retained 11 and 10 per cent. Saudi Arabia gained 7 per cent from UAE and UK gained 37 per cent from Nepal.

5. Summary and Conclusion:

India is well-known for its fruit production around the world. India is home to more than 40 per cent of the world's mango plantations. Mango production was concentrated in Andhra Pradesh, Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Bihar, Gujarat, Kerala, and Orissa in India (Bhaskar and Nirban, 2011). According to the estimated compound growth rate, there has been a considerable increase in the area, production, productivity and export of mango in terms of both quantity and value. The growth of mango export quantity was less than the export in value. According to the transitional probability matrix, the UAE was the largest importer of Indian mango followed by Nepal. Other significant importers, are Saudi Arabia and the United Kingdom. BIMSTEC (The Bay of Bengal Initiative for Multi-Sectoral Technical) and Economic Cooperation, a seven-nation regional grouping comprising (Bangladesh, India, Myanmar, Sri Lanka, Thailand, Bhutan, and Nepal) and SAARC (The South Asian Association for Regional Cooperation, an eight-nation regional grouping comprising Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, Sri Lanka, and Afghanistan) free trade agreements would be beneficial in encouraging greater cooperation. The lucrative markets of wealthy countries have a legally validated Codex compliance framework for Indian mango imports (Kavita Balyan *et al.*, 2015). According to Kumaresh et al., (2013), the government and mango industries must provide marginal and small farmers with infrastructure and cold storage facilities in order to preserve mango quality. As a result, in order to export high-quality mangoes and maximise export earnings, quality control labs can be established and quality assessment can be made mandatory.Developing norms (standards) for producing safe mangos as knowledge advances would make it easier to grant, maintain and move forward with Good Agricultural Practices (GAPs).

6. Competing interests

Authors have mentioned that no competing interests exist.

7. Authors contributions

This work was carried out in the coordination of among all mentioned authors. All the authors involved in the literature search and writing of the manuscript followed by all authors read and accepted the final manuscript.

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