Direction and Destination Pattern of Mango Export from Pakistan: A Markov Chain Approach

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ARTICLE DETAILS

ABSTRACT

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The retention and switching patterns of the importing countries are seen as crucial for the exporting countries to maintain their consistency and growth, where random variables, such as the export of mango from Pakistan, have a significant effect. These actions have a significant role in export of horticulture products like fresh fruits and vegetables. Therefore, this study investigates the importing pattern of the top five importers, (i.e., United Arab Emirates (UAE), Oman, Saudi Arabia, United Kingdom (UK), and Qatar), where Pakistani exports constitute about 70 percent of mango exports. For measuring the occurrence probability of a random variable, the Markov chain analysis is applied to the time series data from FY 2016-17 to FY 2021-22 collected from secondary sources. Based on the TPM, the study concludes that, in terms of quantity, Pakistan can rely on UAE and other category of importing countries for mango exports. In value terms Pakistan can rely on other category of importing nations for mango exports. The Markov chain result showed that the direction of Pakistani mango exports is shifting from a small group of importing countries to other nations in the world. Regulations and direction by the policy makers can improve the production and export of the mango from Pakistan.

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1. Introduction

Fruit, vegetable, ornamentals (flowers, trees, and shrubs), herbal, and medicinal plants are all part of horticulture. A large portion of the world's food supply chain is devoted to horticulture. In terms of sustainability and environmental friendliness, horticulture has a bright future concluded in study conducted by Jaskani and Khan (2021). The study of Jambor and Babu (2016), examined that foreign trade is crucial for a nation's economic development as well as food needs. Trade plays very important
role in the provision of food items as one of the way to make food available in country. The other way is to produce by herself that depends upon the climate of the countries that is not similar in every country.

Mango one of the many horticultural crops grown in Pakistan, hold prominent stand due to its robust yield, high local demand (95%), and sell to other countries potential, add the socioeconomic development of the nation. The mango holds the prominent place among the fruits produced in the country." Mango is the country's official produce in fruits and Pakistan's large size fruit produce in expressions of production and area after citrus. Mangos from Pakistan are renowned across the world for their sweetness, juiciness, nutrition, and distinctive flavor. Pakistan exported 82.7 thousand metric tons of mangos for US$82.7 million in 2016-17, as compare to 52.5 thousand metric tons for US$16.6 million in 2001-2002, the growth rate calculated 2.39 percent; this represents a 58 percent increase in quantity. Pakistan's export-production ratio has gotten worse over time as a result of the lower growth in mango export volume than in mango production from the study by Sadiq Shamoon, Mubarik, and Yasin (2020).

Pakistan is a developing economy with a GDP of 304.952 billion USD and a per capita income of about 1,629 USD in the FY2016-17. The total value of Pakistan's exports of goods and services in 2016–17 was 25.114 billion USD, contributing 8.24 percent to the country's overall GDP report from (WORLDBANK, 2017). The sectors manufacturing (13.5%), services (67%), and agriculture (19.5%) account for the majority of the Pakistani economy (GOP, 2016-17). The agricultural sector continues to be a large contributor to Pakistan's economy and plays a key role in national development, food security, and poverty reduction even if its percentage of GDP has declined over time to 19.5 percent. It is still seen as the main sector for economic growth and, as a result, poverty alleviation from the study conducted by Ayyaz, Bonney, and Akmal (2019).

Behind Mexico, India, Thailand, Brazil, Peru, and the Netherlands, Pakistan is ranked seventh in terms of export volume. It is crucial to realize that the top exporting countries have lower production rankings, showing that they have a high export-to-production ratio. The United Arab Emirates, Saudi Arabia, Oman, and Qatar make up the majority of the Middle Eastern countries that buy most of Pakistan's exports, which are concentrated in a limited group of countries with low-end consumers. Pakistan earns the lowest export price among the top exporters of mangoes. Pakistan is a major producer and exporter of mangoes. Pakistan ranks sixth in the world for mango production, behind India, China, Thailand, Indonesia, and Mexico, with an annual production of 1.7 million metric tons (FAO, 2017). Mango exports from Pakistan rank seventh after those from Mexico, India, Thailand, Peru, Brazil, and the Netherlands. Pakistan exports mangoes to 60 different countries. The United Arab Emirates (UAE), Saudi Arabia, the United Kingdom (UK), the Netherlands, Iran, Malaysia, and a few more countries in the Middle East and Europe are the main travel destinations from the study of Badar (2015).

However, when compared to other significant exporters around the world, Pakistan has the lowest total export value (579 $/ton). According to study by Ghafoor, Mustafa, Zafar, and Mushtaq (2010), The main reasons for Pakistan's lower mango export price are poor product quality, short shelf life, non-compliance with standards, exceeding pesticide residue limits, fruit fly infestation, inadequate packaging, and a lack of traceability. Pakistan's mango output increased during the 2000s at a fair pace of 4.1%, which is comparable to global growth, but the nation has failed to improve its competitiveness in global markets. This is based on the aforementioned macro-level analysis of the mango sector. On the other side, Pakistan was unable to capitalize on the strong expansion of the global mango sell in provisions of export volume and charge. The export-to-production ratio is dropping in the country,
whereas major mango-growing nations are selling a larger share of their products on the global market. Additionally, among the top exporting nations for mango, the country continues to receive the lowest export price despite certain advancements in the mango value chain from the study conducted by Sadiq Shamoon et al. (2020).

It is notable from previous studies that Pakistan’s export pattern for the mango segment is overly dependent on a small number of markets, especially those where there is a sizable Pakistani expatriate’s community. Mango trees are produced all over the world, but the volumes exported to the targeted markets are very substantial and make up a significant share of all exports. In the event that one of the major markets decides not to continue importing from Pakistan, entire sector runs the risk of collapsing from the study by Sadiq Shamoon et al. (2020). This situation demands that direction and destination pattern as well as loyalty of the importing countries should be measured to develop the policies accordingly.

2. Literature Review

The Dynamic Changes in Indian Chili Trade with Markov’s Transitional Matrix was examined by Rajur and Patil (2013). Sri Lanka was found to be particularly loyal to indigenous chili exports and kept approximately 52 percent of its share in the last period, but 39 percent of the Sri Lankan share has gone to the US. Similarly, the United States has retained approximately 39 percent of its previous share. The former share of Indian chili exports from the United States has been lost to other countries such as Singapore, the United Arab Emirates, and Nepal by approximately 28.4 percent. In other countries, Bangladesh lost 88 percent of its former share. Chile exports from India were shown to be strongly preferred in the Sri Lankan market. The study conducted by Varghese (2014) has tested changes to groundnut exports a random variable study from India. It was found that Indonesia and Malaysia were the loyal markets for groundnut exports with a retention probability of 43.02 percent and a retention probability of 59.25 percent respectively. However, India will be unable to maintain its previous export market shares in Ukraine, the United States, the United Kingdom, and the Philippines.

Nair, Thirunavukkarasu, Pandian, Senthilkumar, and Balan (2019), conducted a study, changing pattern of livestock products trade in India to examine that how a random variable (livestock products trading pattern) changes over time. Data were taken from the FAO and APEDA on imports and exports of Indian livestock products for a period from, FY 2010-2011 to FY 2016-17 utilized to estimate future international trade guidelines using the Markov Chain methodology. The transition probability matrix showed that India could not maintain its prior export to Afghanistan and Oman of milk products. India’s past dairy export to the UAE market has been retained by 23.70 percent. The other 76.30 percent were transferred to other countries. In other countries the most likely loyalty/retention of the actual quantity of milk products imported (96.40 percent), followed by import from Denmark (44.20 percent). Indeed, its preceding milk imports from France, Turkey and Italy could not be retained and showed no loyalty during this period.

The study by Adebiyi, Oyatoye, and Kuye (2015), Adebiyi, Oyatoye, and Mojekwu (2015), concluded that the Markov models characterize a system that changes its state over time. Mobile phone subscribers, for instance, move around network operating preferences over time as a system. There was some degree of unpredictable mobility among the mobile phone subscriber. The network operator that a specific customer will switch to in the upcoming period cannot be predicted with precision; instead, it is determined by particular probability provision. These probability provisions have a kind of simple dependence structure where the conditional distribution of the system’s future states only depends on
the most recent information (the decision to quit or stay in a network based on recent service experience).

Rejikumar et al. (2021), conducted a study on structural analysis of Indian gold exports: perspectives for trade policy development. The Markov Chain Analysis also forecasts that the UAE will dominate Indian exports of jewels in the future. Gold jeweler’s world market is US $300 billion, with China, India, the USA, Germany, and Switzerland being significant users. 17.3 percent of global jewellery products were imported into Switzerland in 2017, while its share in India is limited. Similarly, Hong Kong is the second largest importer, accounting for 15 percent of all jewelers in production, but India’s supply is quite limited. A study conducted by Tejaswi, Naik, Kunnal, and Basavaraj (2010) to measure a random variable that is Indian coffee exports by using Markov Chain Analysis for the nine years from FY1994-1995 to FY2002-2003, studied the direction of trade in Indian coffee exports and shifting patterns. In the case of the US, loyalty was high by 80 percent, followed by other nations (51 percent), the Russian Federation (36 percent), Italy (34 percent), Germany (20 percent) and Spain 4 percent, according to the markov chain statistics results.

A study prediction of students’ grades in near future based on Markov Chains conducted by Win (2018) in connection with the modeling of many practical issues, the stochastic processes called Markov chains are typically used. The moveable data averages were found and arranged into five different grade states. The calculation of Markov chains was then used to build a 5*5 transitional probability matrix. The system of equations by employing Chapman Kolmogorov Equations was solved using this transition matrix and five permanent states were identified which were the same on every row of the matrix. These were variables which have the chance of a grade falling into one of the five states for a particular year. The real data can be used to these equations and the next degree can be forecast for the near future. This strategy can be successfully anticipated in near future for grades prediction.

A study on analysis of consumer brand loyalty among Mobile Phone Users in Nigeria Higher Institutions: Markov Chain Approach (Case Study: University of Lagos) by (Sogunro, Ahmmed, Obiwuru, Olaiya, and Olaniyan (2018)), examined the consumer brand loyalty of mobile telephone technology brands via the Markov Chain approach among students from Lagos University in Nigeria. A well-designed questionnaire was used to collect data from 500 university students for the study. The analysis was conducted using the Software Statistical Package for Social Science (SPSS) and R software. The results of this research have shown that Acer brand consumers are 99 percent loyal to the product, but in the future, Apple and Samsung will be able to transit or continue with the percentages of 48 percent and 28 percent, respectively. Lagos University students have brand loyalty preferences for both Apple and Samsung brand products, both undergraduate and postgraduate students, compared to other mobile phone products.

3. Data and Methodology

The secondary data is used in this study. The data sources are Government websites like Pakistan board of investment, Pakistan horticulture development and Export Company (PHDEC), statistics bureau of Pakistan, various economic surveys of Pakistan, newspaper publication relevant to the current study, ministry of finance, ministry of agriculture and food security, ministry of economic affairs and agriculture marketing and information services Punjab. The product for this study is the export of mango from Pakistan to the world. Time series data is collected from FY 2016-17 to FY 2021-22 in order to best understand the retention and switching behavior of importing nations of mango exported from Pakistan. The data for the exports of mango (HS Code 08045020) was collected for the
top five importing countries, which were UAE, Oman, UK, Saudi-Arabia, Qatar and exports to rest of the world were included in other countries' categories. Pakistan exported 145906.54 tons of Mango valued at 24265.019 million Rupees during FY 2021-22.

3.1 Analytical Tools and Techniques
Excel and LPS software combination was used for analysis of the collected data.

3.1.1 Markov chain analysis
The analysis of the Markov chain was used to analyze the structural changes in any system that may be measured in terms of one result variable during time. The present study examines the dynamic nature of trade patterns in the key importing nations, which represent the export gains and losses of mango using the Markov model. The chain analysis by Markov entails the development of a "TPM, which indicates that elements show the likelihood of exports changing through time from country to country." The diagonal item is where one evaluates the likelihood of keeping a country’s market share, that is, an importing country’s loyalty to the exports of a given country.

Structural change has been handled as a random process in the current application with five mango importing countries. The assumption was that, in any given time period between the importing countries, average mango exports from Pakistan were dependent on exports in the previous period, and this dependence on all periods was equal. A Markov chain algebraic expression is

\[ E_{jt} = \sum_{i=1}^{n} (E_{it-1} \times P_{ij} + e_{jt}) \]

Where,
- \( E_{jt} \) = Exports from Pakistan 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 this is statistically independent of \( E_{it-1} \)
- \( N \) = the number of importing countries

The linear programming (LP) framework was used for estimation of the transitional probability matrix (T) through a method called the minimization of mean absolute deviation (MAD).

\[ \text{Min}, \ OP^* + le \ldots \]

Subject to,
- \( XP^* + V = Y \)
- \( GP^* = 1 \ and \ P^* \geq 0 \)

Where,
- \( P^* \) = probabilities vector \( P_{ij} \)
- \( O \) = zeros vector
- \( I \) = Dimensional vectors
- \( e \) = Absolute vector errors;
- \( Y \) = share of exports to every nation;
- \( X \) = diagonal matrix of lagged value of \( Y \);
- \( V \) = errors vector
- \( G \) = an alignment matrix to sum the row values of \( P \) given in \( P^* \) to unity.
4. Mango exports in quantity TPM results

The main nations importing mangoes from Pakistan include the United Arab Emirates, Oman, the United Kingdom, Saudi Arabia, Qatar, and the rest of the world were categorized as others. The magnitude of trade losses resulting from rival nations is disclosed in the row elements of the transitional probability matrix. The diagonal element depicts the likelihood that the relevant country will maintain its trade volume from the prior year, while the column element depicts the potential for gains in trade volume from other rival nations.

<table>
<thead>
<tr>
<th>Countries</th>
<th>UAE</th>
<th>Oman</th>
<th>UK</th>
<th>Saudi-Arabia</th>
<th>Qatar</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAE</td>
<td>0.48</td>
<td>0.19</td>
<td>0.25</td>
<td>0.00</td>
<td>0.07</td>
<td>0.00</td>
</tr>
<tr>
<td>Oman</td>
<td>0.57</td>
<td>0.00</td>
<td>0.00</td>
<td>0.27</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>UK</td>
<td>0.00</td>
<td>0.37</td>
<td>0.12</td>
<td>0.00</td>
<td>0.00</td>
<td>0.51</td>
</tr>
<tr>
<td>Saudi-Arabia</td>
<td>0.00</td>
<td>0.00</td>
<td>0.69</td>
<td>0.31</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Qatar</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Others</td>
<td>0.27</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.72</td>
</tr>
</tbody>
</table>

UAE was one of the most stable markets among the top consumers of Pakistan's mango, as evidenced by the chance of retention at 0.48, or the probability that UAE maintains its export share over the study period. Pakistan's mango exports to UAE currently account for 48 percent of the total; of the remaining 52 percent of the UAE market, 19 percent was directed to Oman, 25 percent to UK and 7 percent to Qatar. UAE keeps its 48 percent share while gaining 57 percent from Oman and 27 percent from others. Pakistan can rely on UAE for mango exports. Others was one of the most stable markets among the top consumers of Pakistan's mango, as evidenced by the likelihood of retention, which stands at 0.72, i.e., the probability that Others maintains its export share over the study period. Currently, 72 percent of Pakistan's mango exports go to foreign countries; of the remaining 28 percent of the market, 27 percent went to the UAE and 1 percent went to Qatar. The most reliable and dedicated market for Pakistan's mango exports was elsewhere. Others keep their 72% of the market while obtaining 51% from the UK, 100% from Qatar, and 9% from Oman. Pakistan can rely on others for mango exports (Table 1).

With a moderate likelihood of retention, Saudi Arabia is likely to maintain its 31 percent export market share. It indicates that other importing nations have seized its 69 percent market share. With the right legislation and policy guidance, Pakistan may rely on Saudi Arabia for its mango exports. Qatar maintains its zero percent export share, according to its zero-likelihood retention rate. It implies that other importing nations have seized all of its market share. Qatar cannot be Pakistan's sole source of mango exports. The UK is likely to maintain its current export share of 12 percent despite having a low likelihood of retention. It indicates that other importing countries have surpassed its former 88 percent market share. The UK is not Pakistan's only source of mango exports. Oman maintains its zero percent export share, according to its zero-likelihood retention rate. It implies that other importing nations have seized its entire market share. Pakistan cannot rely on Oman for mango exports (Table 1).
5. Mango exports in value TPM results

Table 2: Transition probability matrix in value of mango export

<table>
<thead>
<tr>
<th>Countries</th>
<th>UAE</th>
<th>Oman</th>
<th>UK</th>
<th>Saudi-Arabia</th>
<th>Qatar</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAE</td>
<td>0.16</td>
<td>0.31</td>
<td>0.41</td>
<td>0.10</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Oman</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.30</td>
<td>0.00</td>
<td>0.70</td>
</tr>
<tr>
<td>UK</td>
<td>0.91</td>
<td>0.03</td>
<td>0.00</td>
<td>0.00</td>
<td>0.06</td>
<td>0.00</td>
</tr>
<tr>
<td>Saudi-Arabia</td>
<td>0.28</td>
<td>0.00</td>
<td>0.09</td>
<td>0.00</td>
<td>0.18</td>
<td>0.45</td>
</tr>
<tr>
<td>Qatar</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Others</td>
<td>0.00</td>
<td>0.00</td>
<td>0.21</td>
<td>0.00</td>
<td>0.04</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Others maintained its previous year's market share of 76 percent. With a value of 26 percent others lost its market share to UK and Qatar. On the other hand, market share was gained by others from Oman and Saudi-Arabia, with an observed value of 70 percent and 45 percent respectively. Others maintained its previous year’s market share of 76 percent. Pakistan can rely on Saudi-Arabia and others in terms of value of export of mango. UAE has a poor probability retention rate of 0.16, which suggests that it keeps its 16 percent export share. It signifies that the remaining importing nations have gained the majority of their market share. Pakistan cannot rely on Oman for mango exports in terms of value.

Qatar maintains its zero percent export share, according to its zero-likelihood retention rate. It implies that other importing nations have seized its entire market share. Pakistan cannot rely on Qatar for mango exports in terms of value. The UK maintains its zero percent export share, according to its zero likelihood retention rates. It implies that other importing nations have seized its entire market share. In terms of value, Pakistan cannot rely on UK for mango exports. Saudi Arabia maintains its zero percent export share, according to its zero-likelihood retention rate. It implies that other importing nations have seized its entire market share. Pakistan cannot rely on Saudi-Arabia for mango exports in terms of value. Oman has one percent probability retention rate, which suggests that it keeps its 1 percent export share. It means that it had lost its 99 percent market share to other importing countries. Pakistan cannot rely on Oman for mango exports in terms of value (Table 2).

6. Conclusion

Horticulture exports, particularly mango contribute significantly to the country's income. During the study period of FY2021-22, Pakistan mango exports had a fantastic performance, according to the reports. Pakistan faces competition in the international market for mango exports from Brazil, Thailand and Vietnam, as well as from India for mango exports. To compete in the global market, Pakistan's export prices must be competitive, as well as meet quality, sanitary, and photo sanitary criteria. When it comes to export competitiveness, quality is crucial. As a result, quality maintenance is crucial. Based on the TPM, the study concludes that Pakistan can rely on UAE and other category of importing countries in quantity for mango exports. In value terms Pakistan can rely on other category of importing nations for mango exports. The Markov chain result showed that the direction of Pakistani mango exports is shifting from a small group of importing countries to other nations in the world. Regulations and direction by the policy makers can improve the production and export of the mango from Pakistan.

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