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Direction of Pigeon Pea Exports from Myanmar- An Application of Markov Chain Model

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ABSTRACT

Background: Pigeon pea (*Cajanus cajan* L.) is the third most important pulse crop of Myanmar. The country was the largest exporter of pigeon pea in south and south-east Asia, accounting for 90 per cent of the overall global export volume. This study focuses to figure out the trend and direction of pigeon pea export from Myanmar.

Methods: This work is based on secondary data and export figures for 10 years were gathered from the Ministry of Commerce and Trade Map. Markov chain model was adopted as an analytical tool to study the direction of pigeon pea trade and a compound annual growth rate was employed to investigate the trend in Myanmar's pigeon pea export for 10 years.

Result: The growth rate of pigeon pea export registered a negative CAGR but was not statistically significant at 5 per cent level of significance. Markov chain analysis of pigeon pea export from Myanmar showed that besides India, Singapore was further a reliable market as revealed through retention probabilities (0.96 and 0.60, correspondingly), while China, UAE, Malaysia, Indonesia and other countries were highly unstable markets for Myanmar pigeon pea.

Key words: Export, Markov chain model, Myanmar pulses, Pigeon pea.

INTRODUCTION

Pigeon pea is an important part of human nutrition, particularly in vegetable-based diets (Singh, 2016). Besides its nutritional benefits, the crop is also used as traditional folk medicine in India, the Philippines, China and some other countries. Additionally, pigeon pea can prevent and used in the treat many diseases like; respiratory, coughs, bronchitis, infections, dysentery, pneumonia, wounds, sores, menstrual disorders, abdominal tumours, diabetes and toothache (Saxena *et al*., 2010). The crop is cultivated almost in all parts of the country. However, a large quantity of the crop comes from Shan state, Sagain, Mandalay and Magwe divisions (Thu *et al*., 2021). Exports are an important factor to promote economic growth, apart from increasing the human workforce and capital inside the country. Exports can perform as an 'engine of growth' in Myanmar, as in the case of East Asia economies (Kim *et al*., 2020).

Myanmar exports a large number of legumes and beans yearly, primarily to India and China and since the country accessed the European markets in 2013, the export trend increased significantly. The country is now the leading exporter of pulses in South and Southeast Asia countries (ICCO, 2020). In 2019, the country fetched US$ 730 million from 1.15 mt of beans and pulses exported to foreign markets (Soe, 2020). India is considered as the most suitable foreign market since the country imported 28 per cent (700,000 MT) of its total bean from Myanmar in 2018/19 (Bard, 2020). India imported about 80-90 per cent of total pigeon pea and 60-70 per cent of total black gram from Myanmar in 2018. Therefore, the domestic wholesale prices of these crops depend almost entirely on India's demand (Nelson, 2018). India's aggregate imports of pulses increased from just 0.25 Mt in 2000-01 to 3.39 Mt in 2012-2013, reflecting an annual average growth rate of about 25 per cent over the 12 years (Kshirsagar, 2014). This happened mainly from Myanmar and Tanzania. The other exporting countries of pigeon pea to India are Malawi, Mozambique and Kenya (Joshi *et al.,* 2015).

Black matpe, Toor whole (pigeon pea) and Mung bean comprise approximately 75 per cent of total Myanmar pulse and beans export in 2019 and China and India are the two leading destinations of the mentioned beans and pulses (Aung, 2020). Besides the three above-mentioned crops, green gram, chickpea, black gram, soybean, cowpea and kidney bean are other exportable varieties of pulses.

Export growth is an important component of economic growth and pigeon pea possesses the potential to play a role (Kim *et al*., 2020) prices of the crop are fluctuating due to the global demand and supply situation. Excessive demand in the international market, principally in India, leads

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to an increase in the number of exports and hence the production surge. On the other hand, a downturn in demand in the international market considerably affects the price and production of the crop. Since India is growing into self-sufficiency in pulses, Myanmar requires to consider new potential export markets and diversify into alternative destinations since there is surplus production of pigeon pea. Accordingly, this research is conducted to evaluate the direction and stable buyers of Myanmar pigeon pea by estimating the probability of retention and switching patterns using a first-order Markov chain model. Additionally, this attempt would help the researchers, organizations and institutions to have a better understanding of the trade of pigeon pea and improve the present analytical framework in the appropriate direction to satisfy the problem situation.

MATERIALS AND METHODS

Myanmar is consisting of 14 provinces or 7 states representing the areas of 7 main ethnic races and 7 divisions, 67 districts, 330 townships, 64 sub-townships, 377 towns, 2,914 Wards and 14,220 villages tracts and 68,290 villages (Globaledge, 2021). The national GDP of Myanmar was $ 76.09 billion and the GDP per capita is about $ 1,273 in 2019 Trading (Economics, 2020). It imports $ 18.68 billion worth of fabric, petroleum products, plastics, fertilizer, machinery, transport equipment, cement, construction materials, crude oil, food products and edible oil. Exports amount to $ 658 million, mainly natural gas, wood products, pulses, beans, fish, rice, clothing, jade and gems. Agriculture contributes 37.8 per cent of the GDP. Over twenty kinds of pulses are grown in Myanmar and occupied around 4.3 Mha in 2018/19 (Moali, 2016) and (Khant, 2018).

Sources of the data

The study was carried out in 2021 at the University of Agricultural Sciences - Bangalore and secondary time series data on the export of pigeon pea from Myanmar for ten years of 2008 to 2017 was obtained from the Trade Map and Ministry of Commerce (MOC).

Subsequenty, markov chain analysis was applied to evaluate the direction of pigeon pea and compound annual growth rate (CAGR) to study the export trend of the crop during the years 2008 to 2017 period using Microsoft excel 2010.

Compound annual growth rate analysis

The time-series data on the export of pigeon pea was analyzed using CAGR using the formula:

$$Y_t = AB^t ut \qquad .....(1)$$

Where,

Y_t = Area (production) during time t.

A = Constant.

t = Time period.

ut = Error term.

B = (1+g).

where

g = Growth rate.

By taking the logarithm, equation (1) was reduced to the following form.

$$\text{Log } Y_t = \text{Log } A + t\,(\text{Log } B) + \text{Log } ut \qquad .....(2)$$

Where,

Log A and log B were the parameters of the function obtained by ordinary least square (OLS) method. Once the above equation is estimated, g can be computed as:

$$g = [\text{Antilog } (B)-1] \times 100 \qquad .....(3)$$

Markov chain analysis

A Markov chain is a very powerful tool used in various fields including physics, economics, engineering, genetics, exports and more. It is a stochastic model which has Markov property. Markov property is satisfied when the current state of the process is enough to predict the future state of the process and the prediction should be as good as making a prediction by knowing their history Walrand and Varaiya (2000). There is an increasing trend of applying the Markov chain model to study the direction and stability of trade and exports by researchers. Mehazabeen and Srinivasan (2020) analyzed the export performance of bananas using Markov chain model, other researchers that used Markov chain model to evaluate the export performance and stability of spices, mango, jaggery, onion, raw cotton, basmati and non-basmati rice are respectively (Mehazabeen and Srinivasan, 2020; Joshi *et al*., 2015; Kusuma and Basavaraja 2014; Revathy *et al*., 2021; Murthy and Subrahmanyam, 1999; Mahadevaiah *et al*., 2005 and Satishkumar *et al.,* 2016).

In this study, the direction of trade and the changes in exports (pigeon pea) were examined by employing the first-order Markov chain model. The dynamic nature of trade patterns was analyzed by applying the first-order Markov process and examining the gains and losses in the export share of pigeon pea in major exporting countries. The export of pigeon pea to a particular country was considered to be a random variable following the first-order Markov process. The pigeon pea exporting countries from Myanmar considered for the study were India, Singapore, China, United Arab Emirates, Malaysia and Indonesia.

The basic assumption of the first-order Markov process is that the export of a commodity (pigeon pea) from a country to its importing countries in any period depends mainly on export in the previous period and this dependence is the same among all periods.

This is algebraically expressed on:

$$X_{jt} = \sum_{(t-1)}^{n} X_{(it-1)} \cdot P_{ij} + e_{jt}$$

Where,

X_{jt} = Export of pigeon pea from Myanmar to j^{th} country during the year 't'.

$X_{(it-1)}$ = Export to i^{th} country during the year t-1.

P_{ij} = Probability of exports will shift from i^{th} country to j^{th} country.

e_{jt} = Error term independent of X_{it-1}.

n = Number of importing countries.

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

$$0 < P_{ij} < 1$$

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

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 2008-2017.

RESULTS AND DISCUSSION

Growth in the export of pigeon pea from Myanmar is presented in Table 1. Pigeon pea exports decreased with a CAGR of (-3.56%) during the years of 2008-17. This is due to the decrease in production and productivity of pigeon pea during this period leading to decline in exports, albeit export is highly associated with demand in international markets (Thu *et al*., 2021). Additionally, reduction of the crop can also come from svere weather and poor introduction of technology in the production process of pigeon pea (Sreelakshmi *et al*., 2012). The value of pigeon pea export was revealed to be $ 240.170 million in 2008 and this figure decreased to $ 99.239 million in 2017 with a CAGR of -2.74% during the years of 2008-17.

Table 1: Trend in the export of pigeon pea from Myanmar.

Years	Quantity (MT)	Value $ (million)
2008	4,71,800	240.170
2009	1,93,977	142.492
2010	1,46,200	121.750
2011	3,19,573	190.445
2012	2,96,124	170.353
2013	1,87,820	114.562
2014	2,54,077	177.294
2015	2,26,686	229.752
2016	1,84,700	159.858
2017	2,24,566	99.239
CAGR (%)	-3.56^{NS}	-2.74^{NS}

Source: (Trade Map, 2018 and Myanmar Ministry of Commerce, 2018).
Note: NS = Statistically not significant.

The transitional probability matrix presented in Table 2 provides a broad indication of changes in the direction of export of pigeon pea from Myanmar during the study period (2010-11 to 2017-18). The major Myanmar pigeon pea importing countries were India, Singapore, China, UAE, Malaysia and all other importing countries were grouped under the category of the 'other' countries. The transitional probability matrix was obtained for the study period by using the actual proportion of exports to different importing countries. This matrix explained the changing direction of Myanmar pigeon pea trade among importing countries which was necessary for taking the proper decision given their expected changes.

The row elements in the transition probability matrix provide the information on the extent of loss in trade, on account of competing countries. The column element indicates the probability of gains in volume of trade from other competing countries and the diagonal elements indicate the probability of retention of the previous year's trade volume by the respective country.

The transition probability matrix of pigeon pea exports from Myanmar indicates that India is a stable destination country for Myanmar pigeon pea this result is inline with findings of (Bard, 2020) that considred India as largest importer of Myanmar pigeon pea. India accounted for 90 per cent of the total export value of pigeon pea from Myanmar in 2017. Similarly, transition probability value of Singapore (0.6073), shows that it is also a stable direction of Myanmar pigeon pea exports. So, India and Singapore have emerged as loyal buyers (Table 2). India gained from Singapore, China and UAE to retain its previous position. This finding supports results of (Kshirsagar, 2014) which indicated a 25 per cent annual growth rate of India's pulse import between 2001 to 2013. While Singapore gained from others (0.7958) of their previous share but lost to India and China. India has been one of the most important markets for Myanmar's pigeon pea and any disruption in trade with India significantly impacts the production of pigeon pea in Myanmar, which calls for government intervention in promoting substitute markets to protect the production of pigeon pea in the country. Singapore and China could be an alternative destination for Myanmar pigeon pea

Table 2: Transition probability matrix of pigeon pea exports from Myanmar (2010-17).

Country	India	Singapore	United Arab Emirates	China	Malaysia	Indonesia	Other
India	0.9686	0	0.0057	0	0.0018	0.0024	0
Singapore	0.2001	0.6073	0	0.1926	0	0	0
United Arab Emirates	0.5239	0	0	0	0.3342	0	0
China	1	0	0	0	0	0	0
Malaysia	0	0	0.07	0	0	0	0.9266
Indonesia	0	0	0	0	0.0865	0	0
Others	0	0.7958	0.2042	0	0	0	0

and the government need to strengthen relationship and ease trade barriers to avoid production and export disruption of the crop.

CONCLUSION

Myanmar's total exports recorded were $ 1.2 billion in 2018. In 2017 about 80-90 per cent of total pigeon pea production and 60-70 per cent of total black matpe were exported to India and the domestic wholesale prices depend almost entirely on India's demand. Other exported beans like green gram (Mung bean), have more extended markets such as Singapore, China, Vietnam, Malaysia, Bangladesh, India, Indonesia and EU countries. India accounted for 90 per cent of the quantity and the total export value was $ 90 million of pigeon from Myanmar in 2017-18 which had decreased compared to previous years due to continued Indian import restrictions. Therefore, the area under pigeon pea is diversified to other crops.

Export quantity of pigeon pea decreased from Myanmar with a CAGR of -3.56 per cent during the years of 2008-17 and the growth in export value of pigeon pea also declined registering a CAGR of -2.74 per cent during the years of 2008-17.

The transition probability matrix revealed that India and Singapore are the major buyers of Myanmar's pigeon pea. Since India is the main buyer of Myanmar's pigeon peas, mung beans and green gram, restriction on the import of pulses by the country drives down the price of pulses drastically.

RECOMMENDATIONS

Myanmar requires to expand and diversify export destinations to other countries like Singapore and China to stabilize the production and export of the pigeon pea.

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