Review Article

An Application of Markov Chain Model to Study on Trade Direction of Export of FCV Tobacco from India

Yogesh HC[1]* and SK Srivastava[2]

[1]*Agricultural Economics from GBPUA&T, IARI, New Delhi, India*
[2]*Professor in the Department of Agricultural Economics GBPUA&T, India*

*Corresponding Author: Yogesh HC, Agricultural Economics from GBPUA&T, IARI, New Delhi, India.

Abstract

Tobacco is one of the important commercial crops of India and also called as "golden leaf". It provides employment directly and indirectly to 38 millions of people. Indian tobacco is exported to over 119 countries across the globe. During 2015-16, India's unmanufactured tobacco (FCV and non-FCV) exports accounted for about 86 per cent of total exports of tobacco and tobacco products in terms of quantity and 71 per cent in terms of value in rupees. Out of the total Indian unmanufactured tobacco exports, FCV tobacco exports constituted 72 per cent in terms of quantity and 81% in terms of value. FCV tobacco exports were in the order of 1,51,670 Metric tons valued ₹ 3,495.81 crores ($ 531.48 million) against 1,49,700 Metric tons valued at ₹ 3,201.71 crores ($ 486.73 million) during the same period last year showing an increase of 1 per cent and 9 per cent in terms of quantity and value, respectively. Therefore, the present study has been conducted with reference to FCV tobacco; to examine the pattern of export destination of FCV (Flue-cured virginia) tobacco. To achieve this, annual export data on region-wise for the period 2010-11 to 2015-16 has been used and analysed by using the first order Markov chain approach. The study reveals that West Europe followed by Africa and North and South America are the best and loyal importer of unmanufactured tobacco from India. Also, it is suggested that India should not only depend on these trade partners only but also diversify its exports to other regions too.

Keywords: Markov Chain Analysis; FCV Tobacco; Trade Direction; Destinational Change; Tobacco Board

Introduction

Tobacco also called "Golden Leaf" is one of the important commercial crops grown in India and being so, it is vital in the Indian economy. It provides direct and indirect employment to 38 million people, around 70 per cent of whom are in the agricultural sector. The combined tax revenue collected annually from tobacco products was ₹ 21,463 crores ($ 3263.09 million) and ₹ 6058.13 crores ($ 921.03 million) in terms of foreign exchange to the National Exchequer, during 2015-16. India has a prominent place in the production of tobacco in the world. India stands second in production of tobacco and third in the export of tobacco in the world. Indian tobacco is exported to over 119 countries across the globe (Tobacco Board, 2016). According to the International Encyclopaedia of Social Sciences, tobacco was first used by the Americans. Tobacco was introduced in India by Portuguese in the seventeenth century. The Kaira district of Gujarat State was probably the first to grow tobacco and subsequently, its cultivation extended to other parts of the country.

Tobacco is an agricultural product processed from the leaves of the plant. Botanically, the tobacco plant belongs to the family Solanaceae and genus *Nicotiana*. The genus *Nicotiana* has more than 60

species, of which two are important and commercially cultivated for the production of tobacco viz., *N. tabacum* and *N. rustica.* About 5 to 6 per cent of the total area under tobacco is accounted for *Nicotiana rustica* varieties, whereas, *Nicotiana tabacum* accounts for more than 85 percent of the total area under tobacco. The rustica varieties known as vilayati and calicutti have dwarf plants with round puckered leaves and yellow flowers. The varieties of tabaccum, which are called desi type, have tall plants with long, broad leaves and usually pink flowers. Varieties of rustica species are used to hookah, chewing and snuff purpose only. However, tobacco produced from rustica species is also preferred for cigarette manufacturing due to its superior quality. Tobacco is also used as a pesticide and in the form of nicotine tartrate, used in some medicines (CTRI- Central Tobacco Research Institute, Rajahmundry, 2016).

World scenario

Tobacco is cultivated in both tropical and sub-tropical climatic parts of the world. About 124 countries produce tobacco on almost 4.3 million hectares of agricultural land, an area larger than Switzerland. China stands first in production followed by India, Brazil, United States, Indonesia, Malawi, Turkey, Argentina, and Zimbabwe. During 2015-16, production 7.5 million tons of tobacco leaves with a productivity of 2087 kg/ha.

The Asian countries had a major share in area and production of the tobacco constituting more than 55 per cent of the world output of tobacco leaves, the major countries being China (42.33 per cent of the world production), India (11.4 per cent), Indonesia (3.4 per cent) etc. African countries like Brazil contributed 10.82 per cent of the total production, while, Malawi 2.02 per cent, and Zimbabwe 1.53 per cent. The USA contributed 4.61 per cent to the total world production (FAOSTAT, 2016).

Indian scenario

Tobacco crop is grown in an area of 0.45 M ha (0.27 per cent of the net cultivated area) producing ∼ 650 M kg of tobacco leaf and a productivity of 1693.9 kg/ha. India is the second largest producer after China and the third largest exporter after Brazil and United States. Among the different tobacco types cultivated in India, bidi tobacco forms the biggest chunk (36 per cent), followed by Virgin-

ia tobacco (16 per cent), Natu tobacco (9.5 per cent) and Hookah tobacco (7.6 per cent). The production of flue-cured Virginia (FCV) tobacco is about 210 million kg from an area of 0.20 M ha while 450 M kg non-FCV tobacco is produced from an area of 0.25 M ha. In the global scenario, Indian tobacco accounts for 10 per cent of the area and 9 per cent of the total production (CTRI - Central Tobacco Research Institute, Rajahmundry, 2016).

During 2015-16, India's unmanufactured tobacco (FCV and non-FCV) exports accounted for about 86 per cent of total exports of tobacco and tobacco products in terms of quantity and 71 per cent in terms of value in rupees. Out of the total Indian unmanufactured tobacco exports, FCV tobacco exports constituted 72 per cent in terms of quantity and 81% in terms of value. FCV tobacco exports were in the order of 1,51,670 Metric tons valued ₹ 3,495.81 crores ($ 531.48 million) against 1,49,700 Metric tons valued at ₹ 3,201.71 crores ($ 486.73 million) during the same period last year showing an increase of 1 per cent and 9 per cent in terms of quantity and value, respectively. The unit price realization from the export of tobacco is around ₹ 230.40 per kg.

Methodology

Data and its sources

Annual export data on region-wise for the period 2010-11 to 2015-16 has been used to analyse the direction of trade and changing pattern of exports of FCV tobacco. Secondary data were collected from Tobacco Board and CTRI (Central Tobacco Research Institute, Rajahmundry).

To examine the pattern of export destination of FCV tobacco, Markov chain analysis was done

Markov chain analysis

The trade directions of exports have been analysed by using the first order Markov chain approach. Central to Markov chain analysis by the estimation of the transitional probability matrix P. The elements P_{ij} of the matrix P indicates the probability that export will switch from country 'i' to country 'j' with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country is retained. Hence, an examination of

the diagonal elements indicates the loyalty of an importing country to a particular country's exports. In the context of the current application, structural changes will be treated as a random process

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

with selected seven importing regional countries. The average exports to a particular regional country is considered to be a random variable which depends only on the past exports to that regional country, which can be denoted algebraically as

Where,

E_{jt} = Exports from India to jth country during the year 't'.

E_{it-1} = Exports to ith country during the period t-1.

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

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

t = Number of years considered for the analysis

r = Number of importing countries.

The transitional probabilities Pij which can be arranged in a (c * r) matrix have the following properties.

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

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

Results

Destinational changes in exports of unmanufactured tobacco from India

Regarding the direction of trade of tobacco to different regions/countries and to study the shifts/loyalty in the exports of tobacco, Markov-chain analysis was employed using the time-series data from 2010-11 to 2015-16. Mandanna [1], Sreenivasa Murthy, D. [2] and Bisht [3], have employed Markov Chain analysis for studying shifts in the direction of trade. The transition probability matrix for shifts in export of unmanufactured tobacco from India is presented in table 1.

The row elements in a transitional probability matrix provide the information on the probability of retention in the volume of trade and the extent of loss in trade on account of competing regions/countries, whereas, the column elements indicate the probability of gains in trade from other competing regions/countries.

An examination of the transitional probability matrix estimated using Markov chain analysis, presented in table 1 reveals that West Europe had retained 33.46 per cent of the previous year's export share in the current period. West Europe had also gained from South and South East Asia (94.27 per cent), Middle East (12.16 per

Regions	West Europe	East Europe	Middle East	South and South East Asia	Africa	North and South Americas	Australasia
West Europe	0.3346	0.1639	0	0.2468	0.1570	0.0977	0
East Europe	0	0.1438	0.2055	0.6507	0	0	0
Middle East	0.1216	0.3778	0	0.0509	0.4175	0	0.0322
South and South East Asia	0.9427	0	0	0	0	0.0573	0
Africa	0.0829	0.2145	0.3295	0	0.2066	0.1665	0
North and South Americas	0.0958	0	0.4375	0.2706	0	0.1961	0
Australasia	0	0	0	0	1	0	0

Table 1: Transitional probability matrix for shifts in export of unmanufactured tobacco from India (2010-11 to 2015-16).

cent), Africa (8.29 per cent) and North and South America (9.42 per cent). West Europe had also lost its previous year import share of unmanufactured tobacco to mainly South and South Asia (24.68

per cent), East Europe (16.39 per cent) and Africa (15.70 per cent). During this period West Europe exhibited a strong preference for unmanufactured tobacco from India.

Africa was next in order retaining 20.65 per cent of the previous year's share in the current year, gaining mainly from Middle East (41.75 per cent) and West Europe (15.70 per cent). Africa had also lost its previous year's share substantially to Middle East (32.95 per cent), East Europe (21.44 per cent) and North and South America (16.65 per cent). However, North and South America had retained 19.60 per cent of previous year's share in the current period, it gained mainly from Africa (16.65 per cent) and meagerly from South Asia and West Europe. North and South America had also lost its share to Middle East (43.75 per cent) and South and south East Asia (27.06 per cent).

Further, East Europe had retained 14.37 per cent of the previous year's share in the current year, gaining mainly from Africa (21.44 per cent), Middle East (37.77 per cent) and West Europe (16.39 per cent). East Europe had also lost its share to South and south East Asia (65.06 per cent) and Middle East (20.55 per cent). Middle East, South and South East Asia and Australasia had not retained any share of the previous year's share, hence are seen as unstable markets for our unmanufactured tobacco. These markets did not exhibit any preference for unmanufactured tobacco from India.

Middle East, even though had not retained any share of our exports of the previous year, had gained from North and South America (43.75 per cent), Africa (32.9 per cent) and East Europe (20.55 per cent). On the other hand Middle East lost its entire share of the previous year imports from India to Africa (41.75 percent), East Europe (37.77 per cent) and West Europe (12.16 per cent). Similarly South and South East Asia, while not retaining any share, gained substantially from East Europe (65.06 per cent), North and South America (27.06 per cent) and West Europe (24.67 per cent). However, it lost its share to West Europe (94.27 per cent) and Australasia lost to Africa (100 per cent) and gained from Middle East.

The perusal of the table 1 indicates that West Europe followed by Africa and North and South America are the best and loyal importer of unmanufactured tobacco from India. It is suggested that India should not only depend on these trade partners only but also diversify its exports to other regions too [4-14].

Summary

The direction of un-manufactured tobacco exports to different regions have been estimated through the transitional probability matrix using Markov chain for the period 2010-11 to 2015-16. The analysis revealed that West Europe followed by Africa exhibited a strong preference for un-manufactured tobacco from India.

Conclusion

Export of unmanufactured tobacco should be diversified instead of heavily depending on one or two regions. The study has identified West Europe, Africa and North and South America preferring Indian tobacco. Export diversification helps in stabilising the export trade.

Acknowledgement

Bibliography

1. Mandanna PK., *et al*. *"*Structural change in India's tobacco exports: a Markov chain approach". (1998).

2. Sreenivasa Murthy D and Subrahmanyam KV. "Onion export markets and their stability for increasing India's exports: Markov chain approach". *Agricultural Economics Research Review* 12.2 (1999): 118-128.

3. Asha Bisht., *et al*. *"*Export of fruits from India: Growth and SPS Issues". *Economic Affairs* 60.2 (2015): 339-346.

4. Adhikari Anup and MK Sekhon. "Export of Basmati rice from India: performance and trade direction". *Journal of Agricultural Development and Policy* 24.1 (2014): 1-13.

5. Bagalkoti Jyoti B., *et al*. "A Markov chain analysis of cardamom export from India". *Journal of Pharmacognosy and Phytochemistry* 8.4 (2019): 1573-1575.

6. Chand R and Tewari SC. "Growth and instability of Indian exports and imports of agricultural commodities". *Indian Journal of Agricultural Economics* 46.2 (1991): 159-165.

7. Gangadhar Varun. "Forecasting of instant coffee exports of India using transitional probability matrix". *Research Journal of Mathematical and Statistics* 7.2 (2019): 13-20.

8. Joshi Deepika., *et al. "*Stability analysis of Indian spices export– a Markov chain approach". *Economic Affairs* 60.2 (2015): 257-262.

9. Padmanaban, K., *et al. "*Export of cashew kernel from India: its direction and prediction". *Economic Affairs* 59.4 (2014): 521-528.

10. Patted Nataraj., *et al. "*Dynamics of Indian FCV Tobacco in International Market". *Research Journal of Agricultural Science* 4 (2013).

11. Phuke KD., *et al. "*Export potential of banana in India". *Agricultural Marketing* (2004): 16-22.

12. Satishkumar M., *et al. "*Growth, export performance and competitiveness of basmati and non-basmati rice of Indiaan Markov chain approach". *International Journal of Agriculture, Environment and Biotechnology* 9.2 (2016): 305-311.

13. Singh Mahendra. "Projection of potato export from India: a markov chain approach". *Potato journal* 37.1-2 (2010).

14. Yabannavar, Girija. "Destination and direction of Indian basmati rice exports-a markov chain approach". *Osmania Journal of International Business Studies* 4.1 (2009).