

## Structural Change Analysis of Groundnut Export Markets of India: Markov Chain Approach

Jhade Sunil\*<sup>1</sup> and Abhishek Singh<sup>2</sup>

Received: 29 Jan 2021 | Revised accepted: 27 Mar 2021 | Published online: 30 Mar 2021

© CARAS (Centre for Advanced Research in Agricultural Sciences) 2021

### ABSTRACT

Groundnut or Peanut (*Arachis hypogea*) is the major oilseed of India. Groundnuts are essential protein crops in India and grown mostly under rain-fed conditions. India occupies first in terms of area and second position in terms of production. China is the largest producer as well as consumer of groundnut in the world with 166.24 lakh tonnes followed by India 68.57 lakh tonnes. India exports groundnut to more than 75 countries. The country has exported 6,64,436.00 MT of groundnuts to the world for the worth of ₹5,096.39 crores during the year 2019-20. This study is to analyze the structural change in the export of groundnut from India to different major import markets by using the Markov chain model. Secondary data on groundnut yearly export data from India to other countries, were collected from 2009-10 to 2019-20. Markov chain analysis were used to obtain the results. The results have shown 'other countries' category, Malaysia, and Russia as stable destination for Indian groundnut exports. Other traditional importing countries such as Indonesia and Thailand countries are unstable (low retention probabilities) export share to these markets. Philippines, Socialist Republic of Vietnam, Ukraine, and United Arab Emirates are the most unstable markets among importing countries. Predicted export shares of groundnut to major importing countries revealed that the export share of Indian groundnut is predicted next four years in that highest to Indonesia as 33.18 per cent and lowest to United Arab Emirates as 1.35 per cent. The study highlights the opportunity to invest in global trade of groundnut for the stakeholders involved in groundnut trade.

**Key words:** Groundnut, Export, Structural change, Markov-chain

Groundnut or peanut (*Arachis hypogea* L.), is a leguminous crop plant that is widely cultivated in the tropics and subtropics between 40°N and 40°S latitudes. It is valued for its high-oil edible seeds and as such, it is the fourth most important source of edible oil and the third most important source of vegetable protein in the world [1]. Groundnut is not only an important oilseed crop of India but also an important agricultural export commodity. With annual all-season coverage of about 70 lakh hectares, globally India ranks first in groundnut acreage and with an output of approx. 80-85 lakh MT (in-shell groundnuts), second in production. Although in various states of India groundnut is cultivated in one or more (Kharif, rabi, and summer) seasons, nearly 80% of acreage and production comes from Kharif crop (June-October) [2].

Groundnut is called the 'king' of oilseeds. It is one of the most important food and cash crops of India. Its play

important role in bringing down the oil deficit in India. Groundnut is particularly valued for its protein content with 26 per cent protein. Many cosmetics contain peanut oil and its derivatives. Peanut protein is used in the manufacture of some textile fibers. Peanut shells are used in the manufacture of plastic, wallboard, abrasives, fuel, cellulose, and mucilage [3].

India occupies first in terms of area and second position in terms of production. China is the largest producer as well as consumer of groundnut in the world with 166.24 lakh tonnes followed by India 68.57 lakh tonnes [3]. The major growing states in India are: Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Rajasthan, Madhya Pradesh, Orissa, and Uttar Pradesh, respectively. The area under groundnut of India was 40.12 lakh ha in 2018-19 [4]. The production of groundnut in India was 37.70 lakh tonnes in 2018-19. Gujarat ranked first with a share of 42.31 per cent among the Indian states. Rajasthan and Andhra Pradesh were in the second and third positions with a share of 15.28 per cent and 8.08 per cent [5].

India exports groundnut to more than 75 countries. The country has exported 3,40,256 MT of groundnuts to the world for the worth of ₹ 1425.93 crores during the year 2009-10. The country has exported 6,64,436.00 MT of groundnuts to the world for the worth of ₹ 5,096.39 crores during the year 2019-20 indicating the increase of export value of groundnut [www.apeda.com]. The major Export Destinations are Indonesia, Vietnam, Philippines, Malaysia, Thailand, Ukraine,

#### \*Jhade Sunil

suniljhade13@gmail.com

<sup>1</sup>Department of Agricultural Engineering, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi - 221 005, Uttar Pradesh, India

<sup>2</sup>Department of Agricultural Engineering, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi - 221 005, Uttar Pradesh, India

Russia, and United Arab Emirates. Several factors have contributed to the variability in exports; these included large domestic consumption, fluctuations in production due to vagaries of weather, competition from other groundnut growing countries, the insufficient exportable surplus of groundnut production during certain years and the absence of a steady export policy. Therefore, an attempt was made to quantify the changing structure of Indian groundnut exports. The main objective of the paper was to study the structural change in groundnut exports [6].

## METHODS AND MATERIALS

The research study is based on secondary data and the study period is 2009-10 to 2019-20. The data were collected from Agricultural and Processed Food Products Export Development Authority (APEDA), Indian Oilseeds and Produce Export Promotion Council (IOPEPC).

### Markov chain analysis

Markov chain analysis was employed to analyze the structural change in any system whose progress through time can be measured in terms of a single outcome variable [7]. In the present study, the dynamic nature of trade patterns that is the gains and losses in the export of Indian groundnut in major importing countries was examined using the Markov chain model. Markov chain analysis involves developing a transitional probability matrix 'P', whose elements,  $P_{ij}$  indicate the probability of exports switching from the country 'i' to country 'j' over time. The diagonal element  $P_{ij}$  where  $i=j$ , measures the probability of a country retaining its market share or in other words, the loyalty of an importing country to a particular country's exports [8]. In the context of the current application, there were six major importing countries for Indian groundnut, viz. Indonesia, Philippines, Malaysia, Vietnam, Thailand, Ukraine, Russia, United Arab Emirates and UK, and all other countries grouped under others. The assumption was that the average export of groundnut from India amongst importing countries in any period depends only on the export in the previous period and this dependence was the same among all the periods [9]. This was algebraically expressed as

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

Where,

$E_{jt}$  = Exports from India to the  $j^{th}$  country during the year t

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

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

$e_{jt}$  = Error-term which is statistically independent of  $e_{jt-1}$ , and

r = Number of importing countries.

The transitional probabilities  $P_{ij}$ , which can be arranged in a  $(c \times r)$  matrix, had the following properties [10]:

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

2)  $\sum_{i=1}^r P_{ij} = 1$  for all i

The expected export-share of India during a particular period, t, was obtained by multiplying the quantity of exports to the selected six during the previous period (t–1) with the estimated transition probability matrix (P) [11]. The transition probability matrix was estimated in the linear programming (LP) framework by a method referred to as the minimization of Mean Absolute Deviation (MAD) [12]. The probability matrix was estimated for the period 2009-10 to 2019-20. The LP formulation on analysis was stated as:

$$\text{Min } O P^* + I_e$$

Subject to,

$$XP^* + V = Y$$

$$GP^* = 1$$

$$P^* \geq 0$$

Where,

$P^*$  is a vector of the probabilities  $P_{ij}$

O is the vector of zeros

i is an appropriately dimensional vectors of areas

e is the vector of absolute errors

Y is the proportion of exports to each country.

X is a block diagonal matrix of lagged values of Y

V is the vector of errors

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

### Forecasting of export scenario

Prediction of quantity of groundnut export share was made by using the Transitional Probability Matrix [13]

$$B_t = B_o * T$$

$$B_{t+i} = B_{t+i-1} * T$$

Where,

$B_o$  = Quantity exported in Base years,

$B_{t+i}$  = Quantity exported in next year (prediction),

T = Transitional probability matrix

## RESULTS AND DISCUSSION

The changing pattern of groundnut exports was estimated by obtaining the transitional probability matrices. 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 trade among groundnut importing countries which was necessary for taking the proper decision because of their expected changes [14].

Table 1 Transitional probability matrix of Indian groundnut export during 2009-10 to 2019-20

Countries	Indonesia	Philippines	Malaysia	Vietnam	Thailand	Ukraine	Russia	UAE	Others
Indonesia	<b>0.360</b>	0.124	0.000	0.327	0.069	0.029	0.000	0.006	0.085
Philippines	0.748	<b>0.000</b>	0.000	0.000	0.000	0.000	0.000	0.045	0.207
Malaysia	0.018	0.174	<b>0.578</b>	0.000	0.000	0.000	0.000	0.000	0.230
Vietnam soc rep	0.459	0.188	0.264	<b>0.000</b>	0.038	0.022	0.001	0.028	0.000
Thailand	0.000	0.000	0.000	0.509	<b>0.292</b>	0.000	0.199	0.000	0.000
Ukraine	0.882	0.000	0.000	0.000	0.000	<b>0.000</b>	0.118	0.000	0.000
Russia	0.233	0.000	0.000	0.000	0.000	0.225	<b>0.524</b>	0.018	0.000
UAE	1.000	0.000	0.000	0.000	0.000	0.000	0.000	<b>0.000</b>	0.000
Others	0.078	0.000	0.000	0.212	0.011	0.017	0.000	0.011	<b>0.671</b>

Markov chain analysis was applied for annual export data for the period 2009-10 to 2019-20. The major eight

groundnut importers from India, i.e., Indonesia, Philippines, Malaysia, Vietnam soc rep, Thailand, Ukraine, Russia, United

Arab Emirates, were considered for analysis. The groundnut trade with the remaining countries was pooled under other countries. The Transitional Probability Matrix [15] presented in (Table 1) provides a broad indication of changes in the direction of export of groundnut from India for the study period. The row elements in the transitional probability matrix provide the information on the extent of loss in trade, on account of competing countries. The columns element indicates the probability of gains in volume of trade from other competing countries and the diagonal element indicates a probability of retention of the previous year's trade volume by the respective country [16]. It is evident from (Table 1), other countries were the most stable importer of Indian

groundnut as they retained 67.10 per cent of the share from the previous year by losing 21.20 per cent to Vietnam soc rep, 0.7 per cent to Indonesia. Malaysia was another stable importer country of groundnut from India, they retained their original share of 57.80 per cent from the previous year by losing 23.00 per cent to Other countries, 17.40 per cent to Philippines, 0.1 per cent to Indonesia. Indonesia, Thailand countries are unstable (low retention probabilities) export share to these markets. Philippines, Vietnam soc rep, Ukraine, and United Arab Emirates are the most unstable markets among importing countries of Indian groundnut during the period as these the countries did not retain any amount of their share from the previous year.

Table 2 Export share of Indian groundnut to selected countries in (per cent)

Years	Indonesia		Philippines		Malaysia		Vietnam		Thailand		Ukraine		Russia		UAE		Others	
	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict	Actual	Predict
2009-10	40.05	34.34	18.11	8.31	18.76	10.94	0.35	17.59	2.50	3.68	2.31	1.43	0.05	0.80	2.67	1.23	15.20	21.68
2010-11	42.15	30.35	10.61	8.22	16.41	9.67	0.69	19.73	2.65	3.95	2.65	1.76	0.72	1.22	2.45	0.99	21.68	24.11
2011-12	30.35	33.47	6.58	10.81	9.20	12.98	29.00	15.53	3.95	4.53	1.76	2.07	1.22	1.66	0.99	1.50	16.95	17.44
2012-13	31.77	35.93	10.81	11.11	13.12	14.46	26.02	14.63	4.25	4.53	2.07	1.80	0.67	1.46	1.50	1.53	9.80	14.54
2013-14	44.70	33.98	11.85	9.07	11.63	8.82	7.94	19.79	4.53	4.86	2.47	2.11	1.85	2.17	1.53	1.20	13.51	18.01
2014-15	25.88	32.40	9.36	9.78	9.73	12.48	25.94	15.16	4.86	4.41	1.41	2.15	2.20	2.31	0.69	1.56	19.92	19.75
2015-16	32.40	25.68	9.44	7.01	13.45	8.68	3.43	22.01	11.74	6.08	1.52	1.61	0.72	2.90	1.63	1.00	25.66	25.03
2016-17	25.67	29.79	7.01	8.83	8.68	10.83	22.01	16.80	6.08	4.66	1.61	2.30	2.90	2.94	1.00	1.41	25.04	22.44
2017-18	43.48	32.80	8.78	8.50	6.87	6.64	10.09	19.97	2.15	4.25	2.30	2.51	2.94	2.25	1.41	1.22	21.97	21.85
2018-19	41.60	32.18	9.64	7.71	6.14	5.62	7.83	21.14	5.21	4.94	2.76	2.27	2.25	2.55	1.55	1.19	23.03	22.41
2019-20	32.18	33.18	7.17	8.89	5.29	8.64	21.14	17.57	4.52	4.59	2.27	2.45	3.04	2.78	1.97	1.41	22.41	20.48

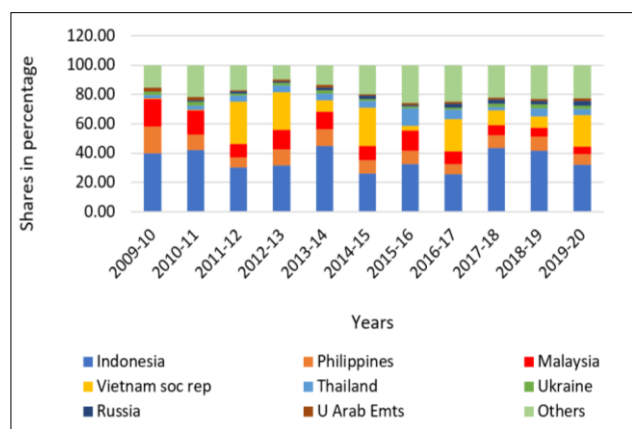


Fig 1 Actual groundnut export share from India

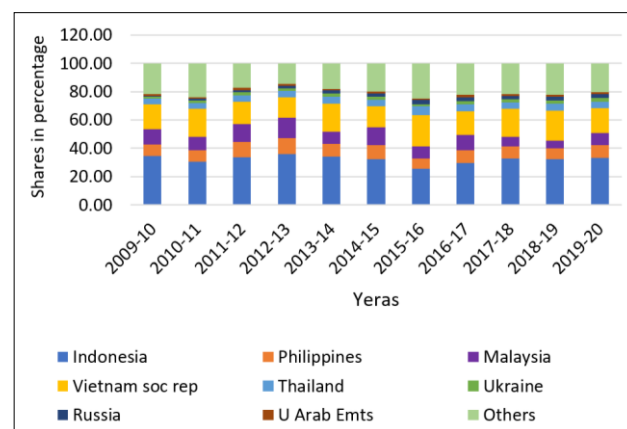


Fig 2 Predicted groundnut export share from India

Table 3 Forecasted export shares of Indian groundnut to major importing selected countries

Years	Indonesia	Philippines	Malaysia	Vietnam	Thailand	Ukraine	Russia	UAE	Others
2020-21	33.18	8.89	8.64	17.57	4.59	2.45	2.78	1.41	20.48
2021-22	32.62	8.93	9.64	17.53	4.52	2.31	2.68	1.36	20.40
2022-23	32.25	9.02	10.21	17.29	4.46	2.27	2.59	1.36	20.54
2023-24	32.04	9.03	10.47	17.17	4.41	2.24	2.53	1.35	20.75

The market share projections of Indian groundnut exports to the major importing countries were computed using the transitional probability matrix [17]. (Table 2) presents the actual and predicted values of Indian groundnut exports to major importers from 2009-10 to 2019-20. The actual share of groundnut export to major importing countries is shown by the percentage bar diagram in fig 1 and the predicted share of groundnut exports to major importing countries shows (Fig 2).

The actual share of Indonesia in groundnut export had shown decreasing trend over the period 2009-10 to 2019-20, it was 40.05 per cent to 32.18 per cent, whereas predicted share slight increases from 34.34 per cent to 33.18 per cent (Table 2). There was a slight fluctuation throughout the period in both actual and predicted share.

With regard to Philippines the actual market share decreasing from 18.11 per cent to 7.17 per cent and predicted

was slightly increases 8.31 per cent to 8.89 per cent respectively from over a period. In case of Malaysia, the actual and predicted proportion of market share shown decreasing trend from 18.76 per cent to 5.29 per cent, and 10.94 per cent to 8.64 per cent respectively. With regards Vietnam soc rep the actual proportion of market share showed increasing trend from 0.35 per cent to 21.24 per cent and predicted export share slightly decreases from 17.59 per cent to 17.57 per cent during the study period shown in (Table 2).

With respect to Thailand, the actual and predicted proportion of exports showed increasing trend i.e., 2.50 per cent to 4.52 per cent, and 3.68 per cent to 4.59 per cent. In case of Ukraine, the actual proportion of exports showed slightly decreases i.e., 2.31 per cent to 2.76 per cent, and predicted increases from 1.43 per cent to 2.45 per cent. With regard to Russia the actual and predicted proportion of market share shown increasing trend from 0.05 per cent to 3.04 per cent and 0.08 per cent to 2.78 per cent. In case of United Arab Emirates, the actual proportion of market share shown decreasing trend from 2.67 per cent to 1.97 per cent, and predicted was slightly increases from 1.23 per cent to 1.41 per cent respectively. Concerning other countries, the actual market share of Indian groundnut exports shows increasing trend from 15.20 per cent to 22.41 per cent and, and predicted was slightly decreases from 21.68 per cent to 20.48 per cent shown in (Table 2).

The export shares of Indian groundnut were forecasted for four years from 2020-21 to 2023-24 and results are

presented in (Table 3). The export share to Philippines, Malaysia, and Other countries shares are expected to rise, Indonesia, Vietnam, Thailand, Ukraine, Russia, and United Arab Emirates countries are expected to fall. The projected percent export share of Indian groundnut to Indonesia around 34 per cent for next forecasted years, other countries and Vietnam soc rep followed next to Indonesia [15].

## CONCLUSIONS

Groundnut is an important oilseed crop in India. It occupies the top two positions in terms of area and second in production. The Markov chain analysis of groundnut exports from India has indicated that minor importers (other countries) of groundnut as the most stable market followed by Malaysia and Russia. Philippines, Vietnam, Ukraine, and United Arab Emirates are the most unstable markets among importing countries. The transitional probability matrix has indicated that India is likely to lose most of its export share in the traditional markets such as Indonesia and Thailand. The forecasted shares have indicated a comparative rise in export shares in Philippines, Malaysia, and other countries. The remaining major importers have remained loyal markets to Indian groundnut, India should not have a high dependency on such countries to avoid trade risks in the long run. Therefore, appropriate export promotional strategies have to be envisaged to diversity the geographical concentration of groundnut export and minimize market risks.

## LITERATURE CITED

1. Palani SV, Vijayalakshmi R, Sathish KR, Palani CV. 2020. Groundnut exports of India-direction and trends. *International Journal of Scientific and Technology Research* 9(6): 397-400.
2. Gayathri J. 2018. A trend analysis of area, production, and yield of groundnut in India. *Shanlax International Journal of Economics* 6(3): 15-21.
3. Rahul B, Gurung B. 2020. Dynamics of area substitution of edible oilseeds in India. *International Journal of Current Microbiology and Applied Sciences* 9(6): 598-603.
4. Lokapur S, Gurikar R, Kulkarni GN. 2014. Production and export of groundnut from India- An overview. *International Research Journal of Agricultural Economics and Statistics* 5(2): 293-298.
5. Varghese N. 2011. Changing directions of groundnut trade in India: The WTO effect. International Conference on Applied Economics – ICOAE, New Delhi. p.731-736.
6. Bansal RK, Gondaliya VK, Shaikh AS. 2017. A review of the status of the groundnut production and export of India. *Indian Journal of Economics and Development* 13(2): 369-374.
7. Dent WT. 1967. Application of Markov analysis to international wool flows. *Review of Economics and Statistics* 49(2): 613-616.
8. Yogesh HC, Srivastava SK. 2020. An application of Markov Chain Model to study on trade direction of export of FCV tobacco from India. *Acta Scientific Agriculture* 4(9): 562-569.
9. Mahadevaiah GS, Ravi PC, Chengappa PG. 2005. Stability analysis of raw cotton export markets of India – Markov chain approach. *Agricultural Economics Research Review* 18(2): 253-259.
10. Sathish S, Khadar Babu SK. 2017. Markovian prediction of future values for food grains in the economic survey. *IOP Conference Series: Materials Science and Engineering* 4(2): 141-148.
11. Mohandas K, Indhusree A, Kuruvila A. 2018. Exports of vegetables from India: An economic analysis. *Journal of Tropical Agriculture* 56(1): 34-44.
12. Joshi D, Singh HP, Gurung B. 2015. Stability analysis of Indian spices export—a Markov chain approach. *Economic Affairs* 60(2): 257-262.
13. Siddeshwar, Shiraganvi S, Guledagudda SS. 2017. Stability analysis of chickpea export markets of India – Markov chain approach. *International Journal of Current Research* 9(2): 46542-46544.
14. Kumar P, Badal PS, Achoth L. 2007. Changing direction of Indian mango exports. *Indian Journal of Agricultural Marketing* 21(1): 130-137.
15. Kusuma DK, Shreeshaail R. 2016. Production and export performance of Indian onion-Markov chain analysis. *Agriculture Update* 11(1): 70-74.
16. Manjunath N, Lokesh H, Deshmanya BJ. 2017. Direction of trade and changing pattern of Indian marine products exports. *Indian Journal of Agricultural Research* 51(5): 463-467.
17. Shilpa SJ, Pandian SSA, Chandrasekar GK, Thangarasu S, Vinothini P. 2017. Assessing the trade performance of poultry products in India – an application of Markov chain analysis. *International Journal of Pure and Applied Bioscience* 5(1): 986-991.