



A Study on Indian Onion Export Performance: Markov Chain Approach

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ABSTRACT

The present study is under taken to understand the growth, stability and direction of Indian onions exports to worldwide. Compound growth rate, Cuddy- Della Valle index and Markov chain analysis was worked out to find the growth rate, instability and growth transition of onion exports from India to all over the world for the period of 1991-92 to 2013-14. The results concluded that quantity of onion exported to Bangladesh growing at the rate of 16.58 per cent per annum but for Singapore onion exports decreases with 2.83 per cent per annum. Singapore was more instable onion importer with 17.87 per cent instability index value followed by Nepal with 16.17 per cent instability index value. Malaysia show more stability compare with Sri Lanka and Bangladesh to imports onions from India, the instability index value are 4.64 per cent, 6.68 per cent and 7.42 per cent respectively. Sri Lanka retained highest its original share extent of 68.27 per cent after Bangladesh and Singapore with share of 83.71 per cent and 74.55 per cent respectively. The future market shares of Indian onion to the major importing countries were projected up to 2019-20 using the transitional probability matrix, Bangladesh and Nepal show slightly decreasing trends same as for Malaysia, Singapore, Sri Lanka and other countries predicted values show increasing trend.

Key words: Growth rates, Instability index, Export performance, Onion exports, Markov chain analysis

India is the second largest producer of onion in the world after China. It enjoys 20.84 per cent share of the global onion production during 2016 (FAOSTAT 2016). For the year 2017-18 India's onion area, production, productivity, export in total quantity and value was 1285.00 ('000 ha), 23262.31 ('000 MT), 18.10 (Ton/ha), 2135421.57 MT and ₹ 438436.00 (Lakhs) respectively (APEDA 2018). The Major Onion producing states area Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana and Telangana. Among all the states Maharashtra ranks first in Onion production with a share of 28.32 per cent. Indian onions has two crop cycles,

first harvesting starts in November to January and the second harvesting from January to May. Worldwide Indian onions have good demand, Major export destinations of onion from India are Bangladesh, Malaysia, Singapore, Sri Lanka, Nepal, etc.

MATERIALS AND METHODS

Secondary time series data from 1991-92 to 2013-14 on the onion export quantity from India have been collected from Horticultural statistics at a glance, National horticulture board, NAFED annual reports and "Indiastat" website. The statistical techniques used for this study were

annual compound growth rate (ACGR) model to know growth in quantity of export to world, Cuddy Della Instability index was used to study the stability of exports of onions and Markov chain analysis was used to study the export performance of onion. The analytical tools employed in the present study are elaborated as under.

Annual compound growth rate

The growth in quantity of export of onion was analyzed using the annual compound growth rate (ACGR) model. Time series data from 1991-92 to 2013-14 on quantity of onion exports was used to apply Cobb-Douglas Production function of the following form to know the compound growth rates of quantity of onion exports.

$$Y_t = ab^t$$

The above equation was transformed into log linear form and written as:

$$\log Y = \log a + t \log b + \mu_t \text{ where,}$$

Where,

Y_t = Onion exports during the selected reference period,

't' = Years which takes value 1, 2,.....n,

μ_t = Disturbance term in year 't',

a and b are constant and parameters to be estimated respectively.

The above equation will be estimated by using Ordinary Least Squares (OLS) technique.

$$\text{CGR} = \text{antilog of } (\log b^{-1}) \times 100$$

Where, log b is the parameter estimated

Instability analysis

Instability index was used to study the stability of exports of onions over the years. The formula suggested by Cuddy Della (1978) was used to compute the index of instability is:

$$\text{Index of Instability} = \frac{\text{Standard Deviation } (\sigma)}{\text{Mean } (X)} \times 100 (1-R^2)$$

Markov chain analysis

Markov chain model is a stochastic model describing a sequence of possible events based on the probabilities of each event depends on the state attained in the previous event. The element P_{ij} of transitional probability matrix indicates the probability that exports will switch from the country i to the country j with time (t). The diagonal element P_{ii} measures the probability that the export share of a country will be retained. Hence, examination of diagonal element indicates the loyalty of an importing country to a particular country's exports. In the context of the current application, the average exports to a particular country was

considered to be a random variable which depended only on its past exports to that country and which can be denoted as Equation (1):

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

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,

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

r = Number of importing countries.

The transitional probabilities P_{ij} , which can be arranged in a (c×r) matrix, have the following properties

$$0 < P_{ij} < 1 \quad \dots\dots\dots(2)$$

$$\sum_{i=1}^r P_{ij} = 1 \text{ for all } i \quad \dots\dots\dots(3)$$

Thus, the expected export shares of each country during period t were obtained by multiplying the exports to these countries in the previous period (t-1) with the transition probability matrix.

The transition probability matrix was estimated in the linear programming (LP) framework by the method referred to as Minimization of Mean Absolute Deviation (MAD), the LP formulation is stated as:

$$\text{Min } O'P^* + Ie \quad \dots\dots\dots(4)$$

$$\text{Subject to, } XP^* + V = Y$$

$$GP^* = 1$$

$$P^* \geq 0$$

Where,

P^* = vector of the probabilities P_{ij} ,

O = vector of zeros,

I = appropriately dimensional vector of areas,

e = vector of absolute errors ($|U|$),

Y = vector of exports to each country,

X = block diagonal matrix of lagged values of Y,

V = vector of errors,

G = grouping matrix to add the row elements of P arranged in P^* , to unity.

RESULTS AND DISCUSSION

Compound growth rate and Cuddy- Della Valle index was worked out to find the growth and instability of onion exports from India to all over the world. The compound growth rate of onion exports from India to different countries is presented in (Table 1).

Table 1 Annual growth rate and instability of onion exports from India to different countries

Country	ACGR	Adjusted R Square	Cuddy Della Valle Index
Bangladesh	16.58	0.68	7.42
Malaysia	7.68	0.79	4.64
Nepal	8.73	0.31	16.17
Singapore	-2.83	0.18	17.87
Sri Lanka	5.23	0.69	6.68
Others Countries	6.83	0.53	10.23
Total exports	8.29	0.75	5.32

The results revealed that there was a positive and significant growth in export of onion except for Singapore. Quantity of onion exported to Bangladesh growing at the rate of 16.58 per cent per annum (with 0.68 R^2 value) but for Singapore onion exports decreases with 2.83 per cent per annum (with 0.18 R^2 value). Total onion exports from India to other countries showing 8.29 per cent growth per annum with 0.75 R^2 value, it indicates that Indian onions have demand in international market. Instability index values are constructed to know which country was more consistence to importing onions from India. From (Table 1) we concluded that Singapore was more instable onion importer with 17.87 per cent instability index value followed by Nepal with 16.17 per cent instability index value. Malaysia shows more stable compare with Sri Lanka and Bangladesh to imports onions from India, the instability index value are 4.64 per cent, 6.68 per cent and 7.42 per cent respectively. Total

onion exports to worldwide show 5.32 per cent instability index value, it represent after meeting domestic consumption of onion, surplus onions are exported to worldwide market to get remunerative price for quality product, improve income of farmer and reduce much price downfall during bumper crop or high production conditions.

The major Indian onion importing countries were Bangladesh, Malaysia, Nepal, Singapore, Sri Lanka and all other importing countries were grouped under the category of the other countries. From 1991-92 to 2013-14 period was considered for analysis. The row elements in the transitional probability matrix provide the information on the extent of loss in trade. The columns element indicates the probability of gains in volume of trade from other competing countries and the diagonal element indicates probability of retention of the previous year's trade volume by the respective country (Table 2).

Table 2 Transitional probability matrix of Indian onion exports (1991-92 to 2013-14)

Country	Bangladesh	Malaysia	Nepal	Singapore	Sri Lanka	Others Countries
Bangladesh	0.8371	0.0571	0.0030	0.0000	0.0000	0.1028
Malaysia	0.0377	0.3820	0.0000	0.0000	0.0000	0.5803
Nepal	0.0000	0.0000	0.2424	0.0000	0.0000	0.7576
Singapore	0.0000	0.0000	0.0000	0.7455	0.0000	0.2545
Sri Lanka	0.0000	0.3173	0.0000	0.00000	0.6827	0.0000
Others Countries	0.1188	0.1890	0.0458	0.0223	0.1551	0.4690

The above table indicated that Bangladesh retained its share 83.71 per cent remaining 16.29 per cent loss distributed among Malaysia, Nepal and other countries with 5.71 per cent, 0.30 per cent and 10.28 per cent respectively. It gained 3.77 per cent share of Malaysia and 11.88 per cent share of other countries. Malaysia retains original share of 38.20 per cent and lost to Bangladesh extent of 3.77 per cent and 58.03 per cent to other countries, it gained 5.71 per cent from Bangladesh, 31.73 per cent from Sri Lanka and 18.90 per cent from other countries. Nepal retains its original share up to 24.24 per cent, loss to other countries extent of 75.76 per cent and gained 0.30 per cent and 4.58 per cent from Bangladesh and other countries respectively. Singapore

retained extent of original share is 74.55 per cent, losses 25.45 per cent share to other countries and gained from other countries up to 2.23 per cent. Sri Lanka retained highest its original share extent of 68.27 per cent after Bangladesh and Singapore. Sri Lanka loss 31.73 per cent share to Malaysia and gained 15.51 per cent share from other countries. Onion exports to other countries retains original share extent of 46.90 per cent. Other countries loss share of 11.88 per cent, 18.90 per cent, 4.58 per cent, 2.23 per cent and 15.51 per cent with Bangladesh, Malaysia, Nepal, Singapore and Sri Lanka respectively. It gains major share from Nepal with 75.76 per cent and followed by Malaysia with 58.03 per cent.

Table 3 Projected export of Indian onion to major importing countries

Year	Bangladesh		Malaysia		Nepal		Singapore		Sri Lanka		Others Countries	
	A	P	A	P	A	P	A	P	A	P	A	P
2014-15	454547		252037		27671		29845		178156		415939	
	(33.47)		(18.56)		(2.04)		(2.20)		(13.12)		(30.62)	
2015-16	439446		257354		27134		31524		186139		416596	
	(32.36)		(18.95)		(2.00)		(2.32)		(13.70)		(30.67)	
2016-17	427085		261181		26989		32790		191691		418458	
	(31.45)		(19.23)		(1.99)		(2.41)		(14.11)		(30.81)	
2017-18	417102		264051		27001		33775		195771		420493	
	(30.71)		(19.44)		(1.99)		(2.49)		(14.41)		(30.96)	
2018-19	409095		266256		27067		34556		198872		422347	
	(30.12)		(19.60)		(1.99)		(2.54)		(14.64)		(31.10)	
2019-20	402696		267976		27144		35179		201276		423921	
	(29.65)		(19.73)		(2.00)		(2.59)		(14.82)		(31.21)	

The figures within the parentheses indicate percentages to total exports

A = Actual values

P = Predicted values

The future market shares of Indian onion to the major importing countries were projected up to 2019-20 using the transitional probability matrix and the results of predicted exports and percentage share to total exports of Indian onion have been presented in (Table 3). The above table represents the predicted shares of onion exported from India to different countries during the study period. The projected values were compared with actual values of exports and it indicates a positive trend towards exports of onion from India. The projected values suggested that the percentage of quantity would slightly decreases for both Bangladesh and Nepal from 34.78% and 2.13% in 2013-14 to 29.65% and 2.00% in 2019-20 respectively. For Malaysia, Singapore, Sri Lanka and other countries predicted values shows increasing trend with values 17.96 per cent, 2.02 per cent, 12.19 per cent and 30.92 per cent in 2013-14 to 19.73 per cent, 2.59 per cent, 14.82 per cent and 31.21 in 2019-20 respectively.

The Markov chain analysis revealed that the exports of onion from India to Malaysia is most stable market followed by Sri Lanka and Bangladesh. Surplus onions are exported to worldwide market to get remunerative price for quality product, so as to improve profits of farmer and to reduce much price downfall during bumper crop or high production conditions. From transitional probability matrix, it was concluded that Bangladesh was more persistence to import onions from India and retained its original share extent of 83.71 per cent and follows Singapore and Sri Lanka with 74.55 per cent and 68.27 per cent respectively. When onion domestic prices are fall, there is a need to provide incentives to onion exporters. Government control on export quotas and export policy reforms was stabilize the domestic onion market prices. The projected values were compared with actual values of exports and it indicates a positive trend towards exports of onion from India.

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