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Research Paper

Trade Directions of Indian Basmati Rice Export- Markov Chain Approach

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ABSTRACT

This study aimed to measure the changes in the export direction of Indian basmati rice from 2009-10 to 2021-22 using the Markov chain approach. The data used in the study was obtained from APEDA as secondary time series data. The study found that the export of Indian basmati rice increased in quantity over the study period due to strong demand in the international market, comfortable domestic production, and favorable government policies. Iran and Iraq showed the highest growth rate in both quantity and value of export, while UAE had higher instability in both terms. The study also revealed that UAE and Saudi Arabia were the most stable and reliable markets for Indian basmati Rice, with a probability retention of 76.17 percent and 55.64 percent, respectively. On the other hand, the UK was an unstable market with zero probability of retention. The projected share of different importing countries up to 2027-28 indicated that Iraq and Iran would likely lose their share in the coming years, while UAE, Kuwait, and Saudi Arabia are expected to increase their share in the future. Additionally, the study showed that the export of basmati rice increased over the study period and is a competitive export product. To have a competitive advantage in the export of basmati rice, the government should focus on improving processing facilities, transportation facilities, handling and loading facilities at ports, and quality maintenance to facilitate the export of Indian basmati rice.

HIGHLIGHTS

- India is a major producer and leading exporter of basmati rice and earned more foreign exchange through export of basmati rice.
- The substantial increase in the export of Indian basmati Rice was primarily attributed to its high demand in the global market, favorable government policies, and the ease of domestic production.

Keywords: Basmati rice, Export, Markov chain, Future prediction, Growth rate, Instability Index

Rice is a staple food that covers at least 20 percent of the regular calorie intake of more than the average global population. It has shaped millions of people's cultures, diets, and economics. Asia has engrossed itself above 95 per cent of global rice production and out of all Asian countries, China (213.61 Million Tonnes) has secured 1st place, followed by India (178.30 Million Tonnes) in 2020 (FAO, 2022). The green revolution, which started during the late 1960s, has significantly contributed to attaining the autarky position in the food sector within a decade; consequently, India became a net exporter of food grains. The rapid increase in rice production

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during the green revolution and later period boosted rice export. Rice is among India's most important exportable agricultural commodities, contributing substantially to the national income in 2011–12; rice exports made up 12.85% (by value) of all agricultural exports (GOI, 2013). West Bengal, Uttar Pradesh, Andhra Pradesh, and Punjab are the main states in India that produce rice. Currently, India is leader in both producer and top exporter of basmati rice. India is found to produce about 70 per cent global production of this rice and the leftover Pakistan (Sidhu *et al*. 2014). Despite the presence of numerous aromatic and long graine long-grainedties, basmati rice has a chief aroma, and unique flavor with fluffy texture while cooking as they have been slender grains elongating at least twice their original size. Basmati rice has good export demand and fetches satisfactory prices from export in foreign trading due to such uniqueness. Its higher price in the international market made it export competitive product. Around seven per cent of global rice produced has been traded and this trading has been concentrated among five key exporters constituting 85 per cent of worldwide net trade (Wailes and Chavez, 2012). The major markets for Indian basmati rice during 2020-21 were Iran, Saudi Arabia, USA, UAE, and Kuwait (APEDA 2022). Similarly, major destinations for Indian's non-basmati rice exports are Nigeria, Senegal, Benin, Cote D Ivoire, South Africa and United Arab Emirate.

The rice exporting is strongly correlated to the government's self-maintained buffer stock. India has been a major rice exporter since two years ago to the world's major markets due to decreased per capita consumption and comfortable buffer stock with government agencies due to bumper output. The rapid rate of population expansion is the fact that underlies the strict consumer requirements for rice in the trade environment. Consequently, with the ever-increasing demand for rice, self-sufficiency in producing both basmati and non-basmati rice, and an extra effect of a feeble currency and an easy-going trading policy, it is evident that there is a vast opportunity for rice exportation. There has been evidence of shifting from Indian basmati to non-basmati rice among African countries due to price competitiveness (Chandrashekhar, 2013), suggesting the potential for rice export. Rice production domestically should be promoted to maximize export possibilities. Achieving greater production at the domestic level should be considered by the expansion of irrigated regions, the deployment of high-yielding varieties, and the right application of inexpensive labour. The grower and the miller found getting high numbered prices which were governed by market grade standards constituting color, hulling percentage, recovery of head rice and many others (Ahuja *et al*. 1995).

India's potential for exporting basmati rice depends on two factors: an exportable surplus within India and a market for basmati rice at competitive prices worldwide (Sekhar, 2003). Instead, domestic and global prices of basmati rice play a vital role in determining its export. In the present context, the study has been conducted to portray the trade directions of Indian basmati rice its prospects so that appropriate remedial measures could be adopted well in advance to raise the Indian export share in the global market.

MATERIALS AND METHODS

The study was based on secondary data. The data on top exporting countries were collected from Agricultural and Processed food products Export Development Authority (APEDA), Ministry of Commerce and Industry, Government of India. The data was collected from the year 2001-02 to 2021-22. To estimate the growth rate and instability of major importing countries, used data from 2001-2 to 2021-22 and to carried out trade direction performance used data from 2009-10 to 2021-22. Major countries were selected on the basis of their contribution in total import, seven major countries were selected which collectively import more than 70 per cent of Indian basmati rice.

Compound annual growth rate

Generally, to find out growth performance growth rate was calculated. In present study growth performance of basmati rice export were analyzed by fitting exponential function of the form;

$$Y_t = ab^t e^u$$

Where

Y = Dependent variable i.e. Quantity and Value, a = Intercept, b = Regression coefficient, t = Time variable

The growth rate was obtained for the logarithmic form of the equation as below:

$$Ln\ Y = Ln\ a + t\ Ln\ b$$

where, *Ln Y*, *Ln a* and *Ln b* are natural logarithm of *Y*, *a* and *b* respectively.

The compound growth rate was computed by using the relationship;

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

The significance of the regression coefficient was tested using the students, '*t*' test.

Instability index

To find out fluctuation or variation in time series data, instability index is very common tools that many researchers were used (Ramasamy *et al*. 2005; Gupta and Sharma, 2010). The Instability Index was computed using Cuddy-Della Valle Index;

$$I = CV^{*}(\ 1 - R^{2})^{0.5}$$

where, *CV* is the coefficient of variation and R^2 is the corrected coefficient of determination of the log linear function.

Markov chain analysis

To get a detailed view of trade directions, i.e., the direction which is followed by the export practice of basmati rice, the Markov chain perusal with first order has been applied (Bansal and Singh, 2020). Transitional probability matrix P_{ij} has been used to illustrate the probability of switching of trade between two countries i.e., '*i*' and '*j*', by the pace of time. The probability retention of export contribution of both the countries involved has been computed through *P*. Here in our study, six prime countries involved in exporting of basmati rice from the past decade (2009-10 to 2021-22) have been taken for assessment. Here it has been assumed that the average export of basmati rice in India at any specific time period depends upon the

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

Where, E_{jt} = Exports from India to j^{th} country during the year *t*.

E_{it-1} = Exports from India to i^{th} 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 P_{ij} which can be arranged in a ($c \times r$) matrix, have the following properties—

$$\sum_{j=1}^{r} P_{ij} = 1 \text{ for all } i$$

Thus, here in the transitional probability matrix, the export data got multiplied with that of the previous period (*t*–1) to get the expected export shares of each country during period '*t*'.

Estimation of the P_{ij}

Here in this current analysis, the Minimum Absolute Deviations (MAD) approximation tool has been engaged for evaluating the transitional probability, which has minimized the total of absolute deviations (Fisher, 1967; Wagner, 1959). The conventional linear programming technique has been used to satisfy the properties of transitional probabilities of non-negativity restrictions and row sum constraints in estimation.

The linear programming formulation is stated as—

$$Min\ OP^{*} + Ie$$

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

$$GP^{*} = 1$$

$$P^{*}e \geq 0$$

Where,

0 = vector of zeroes.

*P** = vector in which probability P_{ij} are arranged.

I = appropriate dimensioned column vector of units.

E = vector of absolute error ($|U|$).

Y = vector of export 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 as arranged in P^* to unity.

After calculating the transitional probability matrix, the expected shares of export were calculated by—

$$Y_{jt} = \sum_{j=1}^{r} y_{it-1} \times P_{ij} \; (j = 1,2,3 \ldots r)$$

Where, Y_{jt} = Predicted proportions of j^{th} country's share at time 't'.

Y_{t-1} = Observed proportion of i^{th} country share at time 't–1'.

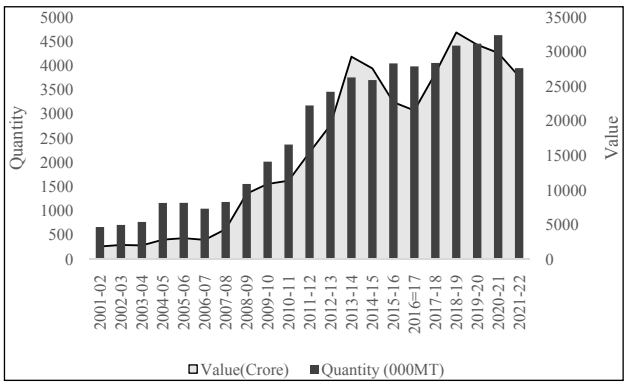
P_{ij} = Estimated transitional probability matrix.

Analysis were done by using LINGO software.

RESULTS AND DISCUSSION

Trend in export of basmati rice

Basmati rice has distinguished character in the country's earnings from international trading. It has been proved to be one of all proven agricultural commodities having maximum contribution in export the earnings received from all rest of the agricultural products. The trend in export of basmati rice during the study period is shown in Fig. 1.



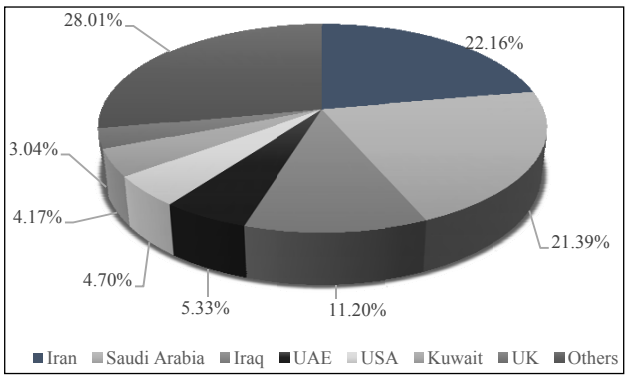
Source: *APEDA (2022).*

Fig. 1: Basmati rice export from India during 2001-02 to 2020-21

Total basmati rice export from India showed an increasing trend over the study period. During 2001-02 the total export of basmati rice from India was 666.72 thousand tonnes, it picked up and showed an increasing trend up to 2020-21, where it marked at 4630.46 thousand tonnes. After that, it had shown a decline trend 4414.58 thousand tonnes during 2021-22. The reason behind this was the covid pandemic, which restricted global trading activities. It has been reported that around 12 percent decline in basmati rice export with respect to the year 2020-21. The increasing quantity of basmati rice exports could be accredited for the increment in basmati rice production. The area and production of basmati rice are growing year by year, which may be due to generating incremental farm earnings and, thereby, superior living standards of the farming community. The export of basmati rice (quantity term), from 2001-02 to 2021-22, comprised the maximum contribution in the aggregate rice export from India.

Export destinations of basmati rice

The key stimulus of destinations for export of any food commodity is majorly defined by geographical and political variances as well as comparative advantage and degree of trade barriers (Kumar, 2008). Major destinations for Indian basmati rice export were selected based on the last three-year average export value. In Fig. 2, the export of basmati rice to the countries like Iran, Saudi Arabia, Iraq, UAE, USA, UK and Kuwait has been depicted. It can be conclude from this figure that, India exporting around 70 percent of total basmati export to above-enlisted partners.



Source: *APEDA (2022).*

Fig. 2: Share of basmati rice export from India to major importing countries during 2019-20 to 2021-22

Growth rate and Instability Index

India's export of basmati rice was highly focused on a few countries, namely Iran, Saudi Arabia, Iraq, UAE, USA, Kuwait, and the UK which shared a major quantity of basmati export. The compound

growth rate of export of basmati rice in terms of quantity and value to major Importing countries was studied for the period 2001-02 to 2021-22. It is evident from table 1 that, Iraq registered the highest growth rate for Indian basmati rice import as it emerged as a new stable market for basmati rice in the last two decades. The growth rate of basmati rice exports to Iraq in quantity was 77.24 per cent and 77.06 per cent in quantity and value, respectively. During the study period, Iran reported 56.25 per cent and 65. 73 per cent growth rate in both (quantity and value) terms. Since 2008, when the Pusa 1121 variety was of rice notified as basmati rice, Iran has become an important buyer of this rice variety (Adhikari *et al*. 2014).

Table 1: Growth rate and Instability of basmati rice export from India during 2001-02 to 2021-22

Country	CAGR (%)		Instabilty Index (%)	
	Quantity	Value	Quantity	Value
Iran	56.25***	65.73***	50.53	54.55
Saudi Arabia	4.06***	10.74***	15.52	23.07
Iraq	77.24***	77.06***	47.42	44.22
UAE	12.53***	18.70***	59.89	49.36
USA	11.44***	17.93***	20.83	22.69
Kuwait	5.45***	11.99***	20.44	31.16
UK	4.81***	9.90***	31.17	25.91
Others	14.52***	21.20***	23.14	23.13

** * *denote significance at 1 per cent level.*

Similarly, other major countries also reported significant growth rate in Indian basmati imports like Saudi Arabia (4.06 %), UAE (12.23 %), USA(11.54), Kuwait (4.45 %) and U.K (4.81 %). India is a major producer and leading exporter of basmati rice and earned more foreign exchange through export of basmati rice. Over the years, there was a fluctuation in the quantity and value export of basmati rice. Instability Indices for major importing countries were presented in the Table 1. It could be seen from the table that, highest instability in quantity was reported for UAE (58.99%) and Iran (54.55%) reported highest variation in terms export value.

Trade direction of basmati rice exports

The policy modelling for a nation's export advancement should keep pace with the rapid switching and global commodity markets. Therefore, proper documentation of any alterations that could help in export promotion policies should be considered. Although the determination of the nature of changes and direction is very difficult to place, the Markov chain analysis has used a unique approach using probability terms for a broad unravelling of the charges. The Markov chain analysis places a high value on approximating the transitional probability matrix because it helps determine the direction of change, whether those changes are going in the right direction, and whether any adjustments are necessary to increase exports in the target market.

The direction of trade of Indian basmati rice export's to various destinations has been studied by approximating the transitional probability matrix (TPM) using Markov chain analysis. The transitional probability matrix (TPM) has been presented in Table 2. The major countries for the study were Saudi Arab, Kuwait, UK, UAE, Iran and remaining importing countries were grouped as others. The diagonal elements in the TPM impart the details on the probability of possession of the trade. In contrast, rest of the world (ROW)

Table 2: Transitional probability matrix of basmati rice export, 2009-11 to 2021-22

Year	Saudi Arab	Kuwait	UK	USA	UAE	Iran	Iraq	Others
Saudi Arab	**0.5564**	0.0449	0.1258	0.0359	0.0852	0.0000	0.0000	0.1518
Kuwait	0.0000	**0.3283**	0.0563	0.0000	0.0830	0.0000	0.0000	0.5324
UK	0.0000	0.0000	**0.0000**	0.0000	0.0000	1.0000	0.0000	0.0000
USA	0.0000	0.0000	0.0000	**0.0880**	0.0000	0.0000	0.0000	0.9120
UAE	0.0691	0.0428	0.0000	0.0000	**0.7617**	0.1264	0.0000	0.0000
Iran	0.3378	0.0670	0.0000	0.0000	0.0000	**0.4856**	0.0000	0.1095
Iraq	0.0040	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0878**	0.9083
Others	0.0308	0.0000	0.0044	0.1048	0.0000	0.3556	0.3228	**0.1817**

Table 3: Projected exports of Indian basmati rice to major importing countries: 2022-23 to 2027-28

(Value Crore)

Year	Saudi Arab	Kuwait	UK	USA	UAE	Iran	Iraq	Others
2022-23	5486.44	1090.48	731.70	1040.24	1849.58	6786.94	2583.46	6847.71
	(20.77)	(4.13)	(2.77)	(3.94)	(7.00)	(25.69)	(9.78)	(25.92)
2023-24	5694.55	1138.40	781.68	1005.64	1966.79	6696.34	2437.13	6696.00
	(21.56)	(4.31)	(2.96)	(3.81)	(7.45)	(25.35)	(9.23)	(25.35)
2024-25	5782.59	1162.42	809.90	994.16	2077.78	6663.20	2375.32	6551.16
	(21.89)	(4.40)	(3.07)	(3.76)	(7.87)	(25.22)	(8.99)	(24.80)
2025-26	5823.35	1176.80	821.69	981.13	2171.81	6637.85	2323.15	6480.76
	(22.04)	(4.45)	(3.11)	(3.71)	(8.22)	(25.13)	(8.79)	(24.53)
2026-27	5841.58	1185.68	827.32	974.07	2248.09	6624.19	2295.84	6419.76
	(22.11)	(4.49)	(3.13)	(3.69)	(8.51)	(25.08)	(8.69)	(24.30)
2027-28	5850.40	1191.76	829.85	967.71	2308.48	6611.13	2273.75	6383.44
	(22.15)	(4.51)	(3.14)	(3.66)	(8.74)	(25.03)	(8.61)	(24.16)

elements stipulates the chances of loss that could be occurred in trading on account of other countries in the competition. The elements shown in a column indicate the probability of trade achievement from the competing countries.

A perusal of Table 2 reveals that in the study period of export, UAE remained the sturdiest market among the prime importers of Indian basmati Rice which were recorded from a higher probability of retention at 0.7617, i.e. the probability that UAE its exports share over the study period was 76.17 per cent. Likewise, Saudi Arab retained its export share to the tune of 55.64 per cent and Iran retained 48.56 per cent of its export share. Kuwait had a 0.3283 probability of retention, which can be similarly defined. UK was an unstable market as it had shown zero probability of retention. UAE had lost of 12.64 per cent to Iran, 6.91per cent to Saudi Arabia and 4.28 per cent to Kuwait, whereas it gained 8.53 per cent from Saudi Arab and 8.30 per cent from Kuwait. Unstable market UK. Total lost its share to Iran. It indicates that the major gainer is Iran. Hence, the results show that UAE was the most stable importer of Indian basmati Rice with a probability retention of 76.17 per cent and UK was an unstable market.

Projection of Indian basmati rice export

The projected exports of Indian basmati rice to major importing partners up to 2027-28 was shown in Table 3. It was estimated that during 2022-23, the major markets for Indian basmati rice would be Iran (25.69 %), Saudi Arabia (20.77 %), and others (25.92 %). The projected exports to Saudi Arabia showed an increasing trend both in absolute value and percentage of total export. It is expected that the total return earned In 2022-23 from basmati rice export to Saudi Arabia will be 5486.44 crores (20.77%) and 5850.40 crores (22.15) during 2027-28. The reason for increasing projected exports to Saudi Arabia is that Saudi Arabia is gaining 33.78 per cent market share from Iran and 6.91 per cent from UAE. This study revealed that our major partner USA also tends to decline their share marginally from 3.94 per cent to 3.66 per cent, which could be due to SPSs concern issues. In the case of Iran the projected value showed a decreasing trend, both in absolute and relative to total export from India; reason behind that its rupee reserves with Indian banks were depleted. The expected share to Iran decreased from 9.78 per cent to 8.61 per cent. The reason for reducing trend in the case of Iran is that it lost its market share to Saudi Arabia and others countries.

CONCLUSION

Indian rice pays significantly to the national income through exports of its basmati as well as non-basmati rice varieties. The study has revealed that Indian basmati rice exports had a tremendous performance during the study period. All the major importing countries showed positive and significant

growth in both quantity and value terms. The result evidence that UAE and Saudi Arabia were the most well-grounded and constant market proved for Indian basmati Rice, with probability retention of 76.17 percent and 55.64 percent, respectively. UK was an unstable market as it had shown zero probability of retention. The projected share of different importing countries up to 2027-28 revealed that Iraq and Iran would likely lose their share in the coming year. In contrast, UAE, Kuwait and Saudi Arabia are likely to increase their share in the future. In order to sustain in the international market, Indian export price needs to be competitive besides meeting quality and sanitary and phyto-sanitary measures.

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