

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 8; August 2026; Page No. 1242-1245

Received: 24-05-2026

Accepted: 28-06-2026

Indexed Journal

Peer Reviewed Journal

Direction of trade and changing export pattern of sugar from India

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DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i8p.4159>

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Abstract

Sugar holds a significant position in India's agricultural economy and global trade basket, contributing substantially to farm incomes, rural employment and foreign exchange earnings. The present study analyzed the direction of trade and changing export pattern of Indian sugar during the period 2004-05 to 2023-24. Export data were collected from the Directorate General of Commercial Intelligence and Statistics (DGCIS), Kolkata, under HS code 170111. The first-order Markov chain approach, employing the Minimum Absolute Deviation (MAD) estimation method, was used to estimate transitional probabilities and assess the dynamics of export destinations. Eight major importing destinations—United Arab Emirates, Malaysia, Sri Lanka, Saudi Arabia, Yemen, Tanzania, Kenya and Nepal—along with a pooled category of 'Other Countries' (comprising 160 importing nations) were considered for the analysis. The results revealed significant instability and structural transformation in India's sugar export trade. The pooled category of 'Other Countries' emerged as the most stable and loyal destination with the highest retention probability of 84.24 per cent (0.8424), absorbing much of the trade share lost by traditional buyers. Among individual importing destinations, Tanzania exhibited the second-highest loyalty with a retention probability of 41.87 per cent (0.4187), followed by Yemen with 30.70 per cent (0.3070). Saudi Arabia retained only 5.87 per cent of its previous share, while the United Arab Emirates, Malaysia, Sri Lanka, Kenya and Nepal recorded zero probability of retention (0.0000), indicating complete instability in their trade shares. These findings indicate that Indian sugar exports have experienced a decisive structural shift away from traditional markets toward diversified non-traditional destinations. The study concludes that formulating stable, predictable export policies, strengthening long-term bilateral trade agreements with growing markets, improving port logistics, and promoting value addition are essential to ensure sustainable growth and global competitiveness of Indian sugar exports.

Keywords: Sugar, direction of trade, export dynamics, Markov chain analysis, transitional probability matrix, minimum absolute deviation, market stability

Introduction

Trade refers to the exchange of goods, services and capital across international borders, playing a fundamental role in global economic integration and resource allocation according to comparative advantage. In developing nations like India, agricultural trade serves as an indispensable catalyst for economic growth, generating vital foreign exchange earnings, expanding market access for domestic farm produce, stimulating agro-processing industries and supporting rural livelihoods.

Sugar is one of the most important agro-industrial commodities in India, with the sugar industry ranking second only to textiles among major agro-based industries in the country. India is the world's largest consumer and second-

largest producer of sugar after Brazil, contributing substantially to global output and international trade. During the recent marketing seasons, India's annual sugar production hovered around 29.5 to 35.0 million metric tonnes. The domestic sugar processing complex encompasses over 500 operational mills supporting more than 50 million sugarcane farmers and around five lakh factory workers, with major production concentrated in Uttar Pradesh, Maharashtra and Karnataka.

India exports substantial quantities of sugar (predominantly classified under HS Code 170111) to more than 160 destinations across Asia, the Middle East, Africa and other regions. However, Indian sugar exports have traditionally been characterized by notable volatility and cyclicity,

influenced by periodic swings in domestic sugarcane output, monsoon rainfall patterns, domestic buffer stocking mandates, export quotas, minimum support/remunerative prices (FRP/SAP), international price parity against major competitors like Brazil and Thailand, and diversion of cane juice for ethanol production. Understanding the changing direction of trade is crucial, as it reflects India's integration into global markets, identifies stable importing partners, and highlights shifts in geographical demand.

Evaluating structural changes in export destinations provides meaningful insights for exporters, trade bodies and policymakers to design targeted export strategies. The first-order Markov chain analysis provides an effective econometric tool to quantify the dynamics of trade direction, transitional gains and losses, and the retention probability of export shares over time. In this context, the present study was specifically undertaken to analyze the direction of trade and changing export pattern of sugar from India over a twenty-year period from 2004-05 to 2023-24.

Materials and Methods

Study Area and Period of Study

The analysis of trade direction was carried out at the all-India national level using secondary time-series data covering a period of twenty years from 2004-05 to 2023-24.

Nature and Sources of Data

The study was entirely based on secondary data. Time-series data on quantity of sugar exported from India to various destination countries were collected from the official publications and trade databases of the Directorate General of Commercial Intelligence and Statistics (DGCI&S), Kolkata, Ministry of Commerce and Industry, Government of India, under HS code 170111 (Sugar). Among India's sugar export destinations, the eight major and consistent importing countries—United Arab Emirates (UAE), Malaysia, Sri Lanka, Saudi Arabia, Yemen, Tanzania, Kenya and Nepal—were selected for detailed empirical examination based on their overall contribution to total sugar export quantity. All remaining importing nations (160 countries) were pooled together under the category of 'Other Countries'.

Analytical Tools: Markov Chain Analysis

The first-order Markov chain analysis was employed to study the direction of trade and structural changes in sugar exports from India. The transitional probability matrix P_{ij} forms the core of the Markov Chain Analysis. The element P_{ij} represents the probability of export share shifting from the i th country to the j th country over time.

The diagonal elements of the matrix indicate the probability of retention of export share by a country, reflecting the stability of trade relationships.

The model can be expressed algebraically as:

$$E_{jt} = \sum E_{it-1} \times P_{ij} + e_{jt}$$

Where,

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

E_{it-1} = Exports from India to i th country during year $t-1$

P_{ij} = Transitional probability from i th to j th country

e_{jt} = Random error term

t = Number of years

r = Number of importing countries

The transitional probability matrix has the following properties:

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

$$\sum_j P_{ij} = 1 \text{ for all } i$$

$$j = 1$$

The expected export shares for period " t " were obtained by multiplying exports of period $(t-1)$ with the transitional probability matrix.

3.5.4.1 Estimation of P_{ij}

The transitional probabilities were estimated using the Minimum Absolute Deviations (MAD) approach. Linear programming techniques were applied to ensure non-negativity and row sum constraints.

The linear programming formulation is:

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

Subject to,

$$XP^* + V = Y$$

$$GP^* = 1$$

$$P^* e \geq 0$$

Where,

O = Vector of zeroes

P^* = Vector of transitional probabilities

I = Column vector of units

e = Vector of absolute errors

X = Block diagonal matrix of lagged exports

Y = Vector of exports to each country

V = Vector of errors

G = Grouping matrix

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

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

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.

Results and Discussion

The structural changes and dynamics in the direction of Indian sugar exports were examined by estimating the transitional probability matrix through the first-order Markov chain model. According to Dent (1967)^[4], the Markov chain approach explains structural changes in any system whose progress over time can be tracked using a single outcome variable. The transitional probability matrix was developed

for the period 2004-05 to 2023-24 based on the actual proportion of sugar exports to the eight major destination countries—United Arab Emirates, Malaysia, Sri Lanka, Saudi Arabia, Yemen, Tanzania, Kenya and Nepal—and the pooled group of 'Other Countries'. Table 1 presents the estimated transitional probability matrix for Indian sugar exports to major destinations.

It is evident from Table 1 that 'Other Countries' was the most stable market for Indian sugar exports, recording the highest probability of retention (0.8424), which indicates that it retained 84.24 per cent of its previous year's import share. This was followed by Tanzania (41.87 per cent) and Yemen (30.70 per cent). Saudi Arabia retained only 5.87 per cent of its previous share, while the remaining importing destinations—United Arab Emirates, Malaysia, Sri Lanka, Kenya and Nepal—recorded zero probability of retention (0.0000), indicating that they were highly unstable markets during the period of the study. Thus, 'Other Countries' emerged as the most loyal destination for Indian sugar exports, whereas UAE, Malaysia, Sri Lanka, Kenya and Nepal were found to be the most unstable markets.

The United Arab Emirates could not retain its previous market share (retention probability of 0.0000). It lost 90.59 per cent of its export share to Sri Lanka, 7.40 per cent to Tanzania and 2.01 per cent to Other Countries. However, the United Arab Emirates gained 29.46 per cent of market share from Malaysia, 4.96 per cent from Kenya and 2.75 per cent from Other Countries.

Malaysia also failed to retain its previous market share, showing zero retention probability (0.0000). It lost 70.54 per cent of its export share to Other Countries and 29.46 per cent to the United Arab Emirates. On the other hand, Malaysia gained a substantial 94.04 per cent of market share from Nepal, 7.29 per cent from Kenya and 6.75 per cent from Other Countries.

Sri Lanka recorded zero retention probability (0.0000), indicating that it was a completely unstable market during the study period. It lost its entire previous market share (100.00 per cent) to Other Countries. However, Sri Lanka captured considerable trade volume from competitors, gaining 90.59 per cent of market share from the United Arab Emirates, 29.84 per cent from Kenya, 13.88 per cent from Tanzania and 1.76 per cent from Other Countries.

Saudi Arabia retained only 5.87 per cent of its previous year's market share (retention probability of 0.0587). It lost 74.47 per cent of its export share to Kenya, 13.80 per cent to Tanzania and 5.42 per cent to Other Countries. Saudi Arabia gained 34.47 per cent of market share from Yemen and 1.41 per cent from Other Countries.

Yemen retained 30.70 per cent of its previous year's market share (retention probability of 0.3070). It lost 34.83 per cent of its export share to Other Countries and 34.47 per cent to Saudi Arabia. Yemen did not gain market share from any of the other major importing countries during the study period.

Tanzania retained 41.87 per cent of its previous market share (retention probability of 0.4187), making it the second most stable destination after Other Countries. It lost 22.40 per cent of its export share to Nepal, 21.85 per cent to Kenya and 13.88 per cent to Sri Lanka. Tanzania gained 7.40 per cent of market share from the United Arab Emirates and 0.81 per cent from Other Countries.

Kenya recorded zero probability of retention (0.0000), indicating complete instability. It lost 42.17 per cent of its export share to Other Countries, 29.84 per cent to Sri Lanka, 15.73 per cent to Nepal, 7.29 per cent to Malaysia and 4.96 per cent to the United Arab Emirates. Kenya gained 74.47 per cent of market share from Saudi Arabia, 21.85 per cent from Tanzania and 5.96 per cent from Nepal.

Nepal also recorded zero retention probability (0.0000). It lost 94.04 per cent of its export share to Malaysia and 5.96 per cent to Kenya. Nepal gained 22.40 per cent of market share from Tanzania, 15.73 per cent from Kenya and 1.34 per cent from Other Countries.

Other Countries retained 84.24 per cent of their previous market share (retention probability of 0.8424), indicating the highest stability among all importing destinations. They lost 6.75 per cent of their export share to Malaysia, 2.75 per cent to the United Arab Emirates, 1.76 per cent to Sri Lanka, 1.41 per cent to Saudi Arabia, 1.34 per cent to Nepal, 0.81 per cent to Tanzania and 0.66 per cent to Kenya. In contrast, Other Countries gained 100.00 per cent of market share from Sri Lanka, 70.54 per cent from Malaysia, 42.17 per cent from Kenya, 34.83 per cent from Yemen, 5.42 per cent from Saudi Arabia and 2.01 per cent from the United Arab Emirates.

The results clearly illustrate significant structural transformation and diversification in India's sugar export trade over the study period. Traditional Asian and Middle Eastern buyers (UAE, Malaysia, Sri Lanka, Saudi Arabia) exhibited high instability and weak retention, reflecting intense international price competition from exporters such as Brazil and Thailand, switching behaviors, and fluctuating domestic export policies. In contrast, emerging East African destinations (Tanzania, Kenya) and the diversified 'Other Countries' group emerged as vibrant, expanding markets. These findings are broadly consistent with previous empirical studies on Indian sugar and agricultural trade dynamics (Shrinatha, 2019; Srivastava *et al.*, 2024; Swarnalatha *et al.*, 2024) [11, 13, 14].

Table 1: Transitional probability matrix of Indian sugar exports to major destination countries (2004-05 to 2023-24)

Countries	UAE	Malaysia	Sri Lanka	Saudi Arabia	Yemen	Tanzania	Kenya	Nepal	Other Countries
United Arab Emirates	0.0000	0.0000	0.9059	0.0000	0.0000	0.0740	0.0000	0.0000	0.0201
Malaysia	0.2946	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7054
Sri Lanka	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Saudi Arabia	0.0000	0.0000	0.0000	0.0587	0.0000	0.1380	0.7447	0.0000	0.0542
Yemen	0.0000	0.0000	0.0000	0.3447	0.3070	0.0000	0.0000	0.0000	0.3483
Tanzania	0.0000	0.0000	0.1388	0.0000	0.0000	0.4187	0.2185	0.2240	0.0000
Kenya	0.0496	0.0729	0.2984	0.0000	0.0000	0.0000	0.0000	0.1573	0.4217
Nepal	0.0000	0.9404	0.0000	0.0000	0.0000	0.0000	0.0596	0.0000	0.0000
Other Countries	0.0275	0.0675	0.0176	0.0141	0.0000	0.0081	0.0066	0.0134	0.8424

Conclusion

From the above results, it is concluded that the direction of Indian sugar exports underwent substantial structural changes during the study period (2004-05 to 2023-24). Traditional importing destinations such as the United Arab Emirates, Malaysia, Sri Lanka, Kenya and Nepal showed complete instability with zero retention probability, while Saudi Arabia retained only 5.87 per cent of its previous trade share. Among individual destinations, Tanzania (41.87 per cent) and Yemen (30.70 per cent) exhibited moderate stability.

In contrast, the pooled category of 'Other Countries' (comprising 160 importing nations) emerged as the most stable and consistent destination with a high retention probability of 84.24 per cent, absorbing much of the trade volume lost by traditional markets. These findings indicate that India's sugar export trade is progressively diversifying into non-traditional global markets. To maintain and expand India's presence in international sugar markets, it is recommended that the government formulate stable and predictable export policies, enter into long-term bilateral trade agreements with stable African and Asian importers, improve port infrastructure and logistics, strengthen market intelligence, and promote value addition and quality certification.

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