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Coffee in Indian Economy: Performance and Prospects

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Coffee is a universal hot beverage, and its international trade volumes point to significant approval in favour of coffee consumption. For many nations in the tropics, coffee is a major source of foreign exchange. This study provides a comprehensive analysis of the global and domestic coffee industry, with a particular focus on India's role based on the secondary data taken from different sources like ITC trade map, Coffee Board of India and international coffee organization statistics, *etc*. In 2022, global coffee production reached 10.89 million tons, with Brazil, Vietnam, and Indonesia leading the output. Despite being the eighth-largest coffee producer, India's export ranking is relatively low due to significant domestic consumption. This study employs standard

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econometric tools, such as compound annual growth rate, Cuddy Della Index, Markov chain analysis, *etc*. The Johansen co-integration test revealed a long-run equilibrium relationship among selected Arabica and Robusta coffee markets. Furthermore, the pair-wise Granger causality test identified unidirectional causality in price transmission among certain Arabica markets, while bidirectional causality was observed among Robusta markets. The paper also highlights the declining coffee yield in India due to biotic and abiotic stressors, despite an increase in production and cultivation area. The study concludes with a discussion on the dynamics of Indian coffee exports, where high domestic demand and fluctuating international prices contribute to the sector's variability. This research provides valuable insights into the performance and prospects of the coffee industry within the Indian economy, offering a basis for future policy and market interventions.

Keywords: Coffee; co-integration; export; international trade; Arabica; Robusta; markov chain analysis.

1. INTRODUCTION

Coffee is one of the three most popular beverages in the world (alongside water and tea), and it is one of the most profitable international commodities. In 1824, Thomas Jefferson affirmed, Coffee is considered as a favorite drink of the civilized world. Coffee cultivation has been a significant contributor to the Indian economy, particularly in the regions of Karnataka, Kerala, and Tamil Nadu, which together account for approximately 97% of the country's coffee production. The Western Ghats, with its ideal climatic conditions, form the backbone of India's coffee industry, producing two main varieties—Arabica and Robusta. Arabica coffee, known for its mild, aromatic flavor, is favored in higher altitudes with cooler temperatures, while Robusta, valued for its strong flavor, thrives in warmer, more humid conditions. The harvest season for Arabica runs from November to January, whereas Robusta is harvested between December and February [1]. India ranks as the eight largest coffee producer globally, contributing around 4.05% to global coffee production. The industry is predominantly export-oriented, with 65% to 70% of the coffee produced being exported, earning significant foreign exchange. In 2023, coffee exports generated approximately US$ 42 billion, marking a substantial increase from US$ 6.7 billion in 2003. Key export destinations include Italy, Germany, and Russia, with Italy being the largest importer of Indian coffee, accounting for 22% of total exports in 2014-15 [2]. The establishment of the World Trade Organization (WTO) in 1995 and India's subsequent compliance with the Agreement on Agriculture (AoA) played a pivotal role in liberalizing the agricultural sector, including coffee [3]. This liberalization, coupled with reduced export subsidies, has allowed India to increase its competitiveness in the international coffee market. However, the industry still faces challenges in achieving stability in production, yield, and export performance. Addressing these issues through technological advancements, improved credit facilities, and effective market integration could significantly enhance India's coffee production and export potential, enabling the country to better compete in the global market [2].

This study aims to assess the performance and prospects of coffee in the Indian economy, analyzing trends in production, yield, and export, while identifying opportunities for future growth.

2. METHODOLOGY

This study is conducted in ICAR – Indian Agricultural Research Institute, New Delhi. In the year of 2022-2023. It is mainly based on secondary data obtained from different sources like ITC trade map, Coffee. Board of India and international coffee organization statistics, etc.

2.1 Growth Rate

The compound growth rates for export of coffee (quantity) was worked out for the both sub-periods and the overall period using compound annual growth rate (CAGR). The compound growth function is specified in the following from.

$$Y_t = ab^t e^u \quad (1)$$

Where,

Y_t = export/production in the year t
t = Time period
a = Intercept value (value of y when t = 0)

b = (1+r), 'r' being the growth rate
u = Error term

Equation (1) was converted into the natural logarithmic form in order to facilitate the use of linear regression. Taking logarithms on both sides we obtain,

$$\text{Ln } Y_t = \text{Ln } a + t \text{ Ln } b + u \quad (2)$$

Ln a and Ln b are obtained by application of ordinary least squares (OLS) procedure to equation (2) and the growth rate r is computed as below:

r = (Anti Ln of Ln b – 1) X 100

2.2 Instability

The Instability Index was computed using Cuddy-Della Valle Index, [4].

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

Where, CV is the coefficient of variation and R^2 is the adjusted coefficient of determination of the log linear function.

2.3 Trade Direction

Dynamics in direction of Coffee exports was examined using stationary form of the first order Markov chain model. This model assumes that: The probability of an outcome on the t^{th} trial depends only on the outcome of the preceding trial, and this probability is constant for all time periods. Markov chain analysis tells about transitional probability matrix 'P' whose diagonal elements indicate the retention probability and off-diagonal elements represent switching-over probability. The general form of the first order Markov model is [5].

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

Where,

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

E_{it-1} = exports to i^{th} country during the year t-1,

P_{ij} = the probability that exports will shift from

i^{th} country to j^{th} country,

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

r = the number of importing countries.

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

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

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

The minimum absolute deviation (MAD) estimation procedure was employed to estimate the transitional probability, which minimizes the sum of absolute deviations [6,7]. The conventional linear programming technique was used, as this satisfies 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 ≥ 0

Where,

O = Vector of zeroes,

P*= Vector in which probability P_{ij} is arranged,

I = Appropriate dimensioned column vector of unit,

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, and
G = Grouping matrix to add the row elements of P as arranged in P* to unity.

2.4 Extent of Integration of Major Coffee Markets

Market integration occurs when the prices of a product in various geographically isolated markets move together over a long period of time. When the price of a commodity changes, and the price of goods of the same quality in other markets changes in the same direction, the

markets are said to be integrated. In order to check the extent of integration between major coffee market 3 major markets for Arabica and Robusta coffee were selected viz., Bengaluru, Hyderabad and Chennai. Following are the steps involved in market co-integration analysis.

2.4.1 Augmented Dickey-Fuller Test (ADF Test) (Dickey, D. and Fuller, W.A. [8])

This test determines whether or not the time series is stationary. If the data is not stationary, then data needs to be transformed in order to check the co-integration, otherwise no integration test can be performed.

2.4.2 Johansen Co-integration Test (Johansen, S. [9]; Johansen, S. [10])

The co-integration of markets was checked using Johansen maximum-likelihood methods after verifying stationarity in the whole price series at the same order of differences. The Johansen co integration test was used to analyse the long-term price relationship between the markets.

2.4.3 Granger causality test (Engle, R.F. and Granger, C.W.J. [11])

To show the causal relationship between the price sequences, the Granger causality test is used. In the vector auto regressive (VAR) model, the presence of causality relationship of the long-run market price relationship can be assessed by using the Granger causality test.

3. RESULTS AND DISCUSSION

3.1 Global Scenario of Coffee Production and Trade

In 2022, global coffee production reached 10.89 million tons, with South East Asia, Africa, and Latin America being the predominant regions. Brazil led the production, contributing 29% of the world's total, followed by Vietnam (18%), Indonesia (7.3%), Colombia (6.1%), Ethiopia (4.5%), Uganda (3.62%), Peru (3.2%), and India (3.1%) (Table 1). In terms of area, Brazil again dominated with a 15.3% share of the global coffee-growing area, followed by Indonesia (10.5%), Colombia (6.8%), and Ethiopia (6%). Vietnam achieved the highest productivity at 2.98 tons per hectare, with Brazil and Honduras following at 1.69 and 1.22 tons per hectare, respectively. These figures underscore Brazil's leading role in both area and production, while Vietnam's exceptional productivity highlights its efficient coffee cultivation practices.

In 2023, global coffee exports were valued at 42,245 million USD, with Brazil leading the market, accounting for 17.4% of total exports. Switzerland (8.6%), Germany (8.07%), Vietnam (8%), and Colombia (6.9%) followed as major exporters (Table 2). Despite being the eighth-largest coffee producer globally, India ranked 18th in exports. This lower export ranking is primarily due to high domestic consumption, with a significant portion of India's coffee production absorbed by its domestic market. These figures highlight the contrasting roles of production and export in the global coffee industry, where India's position as a major producer does not directly translate to a leading export share due to its substantial internal demand.

3.2 Indian Scenario of Coffee Production and Trade

The data in Fig. 1 demonstrates an upward trend in both coffee-bearing area and production from 1990-91 to 2020-21. However, during the same period, coffee yield experienced a decline. The negative growth in yield can be attributed to biotic factors such as increased infestation of white stem borer, coupled with abiotic stress due to erratic weather patterns affecting the coffee-growing regions in India. These challenges have led to a reduction in yield, despite the expansion in production and cultivation area, highlighting the need for addressing these stressors to enhance productivity.

In 2022, Robusta Cherry coffee constituted the highest percentage of India's total coffee exports at 44.35%. This was followed by Instant Coffee, Arabica Parchment, Robusta Parchment, and Arabica Cherry. On the other hand, Roasted Coffee Beans accounted for the smallest share, contributing just 0.02% to the total exports. This data highlights the dominance of Robusta Cherry in India's coffee export market, while the negligible share of Roasted Coffee Beans underscores its limited export potential.

During 2021-22, Italy, Germany, Belgium, the Russian Federation, and Poland emerged as the top five export destinations. Italy remained the largest market for Arabica Cherry, Robusta Parchment, Robusta Cherry, and Roasted Coffee. For Arabica Plantation, Jordan was the leading destination, while Russia dominated as

the primary market for Instant Coffee. The United States was the major market for Ground Coffee, reflecting the diverse global demand for various types of Indian coffee. These results are comparable with those of Gurusamy & Yamakanith, [1].

Table 1. Major coffee producers in the world in 2022. (Production in million tons and productivity in m ha)

Country	Production	%share	Area	% share	Productivity (tons/ha)
Brazil	3.17	29.13	1.87	15.30	1.69
Viet Nam	1.95	17.94	0.66	5.36	2.98
Indonesia	0.79	7.30	1.29	10.51	0.62
Colombia	0.67	6.11	0.84	6.88	0.79
Ethiopia	0.50	4.56	0.74	6.06	0.67
Uganda	0.39	3.62	0.73	5.94	0.54
Peru	0.35	3.24	0.42	3.46	0.83
India	0.34	3.11	0.44	3.58	0.77
Honduras	0.32	2.90	0.26	2.11	1.22
Central African Republic	0.31	2.82	0.76	6.22	0.40
World	10.89	100	12.24	100	0.89

Source: FAOSTAT Database

Table 2. Major players in global coffee exports, 2023. (Value in million US$)

Sl No.	Exporters	Export value	% share in world trade
1	Brazil	7351	17.40
2	Switzerland	3644	8.63
3	Germany	3408	8.07
4	Viet Nam	3382	8.01
5	Colombia	2915	6.90
6	Italy	2586	6.12
7	Honduras	1488	3.52
8	Belgium	1310	3.10
9	France	1271	3.01
10	Ethiopia	1225	2.90
11	Netherlands	1200	2.84
12	USA	1193	2.83
13	Uganda	955	2.26
14	Guatemala	949	2.25
15	Indonesia	929	2.20
16	Peru	829	1.96
17	Canada	764	1.81
18	India	747	1.77
	World	42245	100

Source: ITC Trade map, 2024

Table 3. Types of coffee exports from India 2021-22

Type of Coffee	Quantity in Tons	% of Total Exports
Arabica Parchment	30481	9.95
Arabica Cherry	11798	3.85
Robusta Parchment	28572	9.33
Robusta Cherry	135883	44.35 (Highest)
Roasted Coffee Beans	62	0.02 (Lowest)
Roasted and Ground Coffee	255	0.08
Instant / Soluble Coffee	10760	32.42
Total	306388	100.00

Source: Coffee board of India [12]

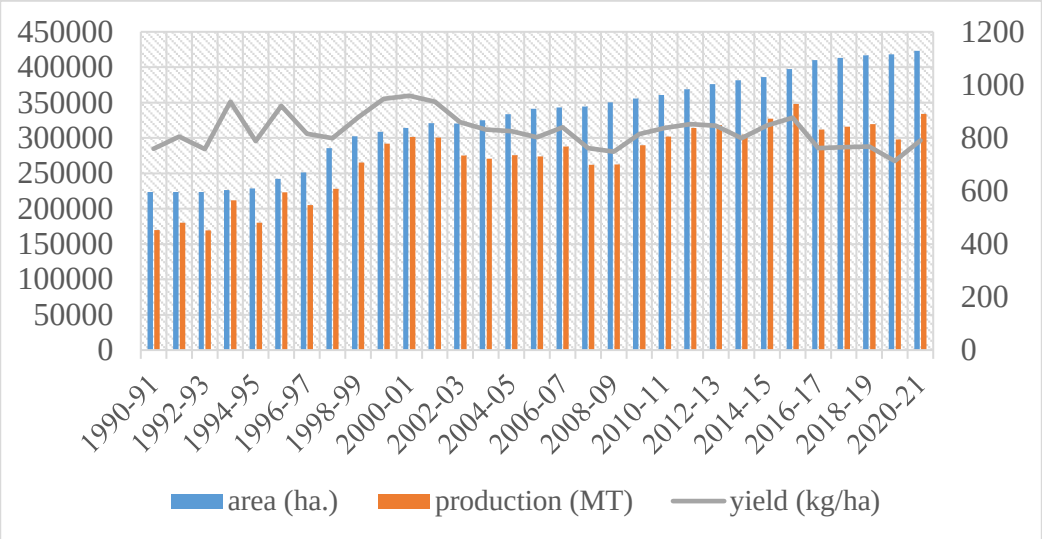

Fig. 1. Area, production and productivity of coffee in India from 1990-91 to 2020-21
Source: Coffee Board of India [12]

Table 4. Exports of coffee by countries and types calendar year 2021-22

Types	Destinations					
Arabica Plantation	**Jordan**	**Kuwait**	**Germany**	**Belgium**	**Italy**	**Others**
% to total	17.70	16.17	14.85	9.65	6.72	34.91
Arabica Cherry	Italy	Belgium	Germany	Russia	Jordan	Others
% to total	25.81	18.37	17.00	5.79	4.51	28.52
Robusta Parchment	Italy	Germany	Belgium	Australia	Korea	Others
% to total	44.75	32.21	4.32	3.59	2.38	12.75
Robusta Cherry	Italy	Germany	Belgium	Russia	Poland	Others
% to total	28.92	12.41	11.14	0.87	0.62	46.05
Instant	Russia	Poland	Malaysia	Turkey	U.S.A.	Others
% to total	14.10	12.23	8.71	6.92	4.94	53.10
Ground	U.S.A.	UAE	Singapore	Australia	Canada	Others
% to total	34.12	20.39	19.61	10.59	4.31	10.98
Roasted	Italy	UAE	U.S.A.	Singapore	Bangladesh	Others
% to total	9.68	3.23	1.61	1.61	1.61	82.26

Source: Coffee Board of India [12]. (Green Bean Equivalent - Quantity in MT)

Table 5 presents the compound growth trend equation used to analyze the growth in coffee exports from 1991 to 2022. The study period was divided into three sub-periods: Period I (1991-2005), Period II (2006-2022), and the overall period (1991-2022). The highest growth rate in export quantity was recorded in Period I, with a 5.69% annual increase. Despite the overall positive trend in coffee export quantity, the sector experienced significant fluctuations due to low coffee prices in both domestic and international markets. The export quantity of coffee exhibited greater variability during Period I, with a 13.03% variation, compared to Period II, which showed a slightly lower variability of 12.87%. However, over the entire study period, the variability was the highest, at 14.04%.

3.3 Trade Direction of Indian Coffee

The trade directions of Indian coffee exports to various destinations were analysed using a transitional probability matrix (TPM) derived from Markov chain analysis. The TPM values, presented in Table 6, highlight the dynamics of coffee exports to ten major importing countries, with other destinations grouped under an "others" category. The diagonal elements of the TPM indicate the probability of retention of export shares, while the row and column elements reflect the probabilities of loss and gain in trade due to competition from other countries. Turkey emerged as the most stable market among major importers, with a retention probability of 0.839, indicating that it retained 83.90% of its original

export share between 2015 and 2022. However, Turkey lost 16.00% of its share to Italy but gained 8.3% from Jordan. Italy also demonstrated stability, with a retention probability of 0.693, retaining 69.30% of its import share. Italy lost 30.00% of its share to Russia but gained significant shares from Jordan (91.7%), Turkey (16.0%), Libya (11.7%), and Germany (6.8%). The "others" category retained 85.4% of its original share, losing portions to Belgium (10.6%), Malaysia (3.3%), and Germany (0.7%), while gaining from Poland (72.7%), Germany (46.9%), and Indonesia (22.2%). Conversely, Russia, Belgium, Libya, Malaysia, and Jordan exhibited zero probability of retention, indicating their instability as importers of Indian coffee. These results are on par with study conducted by Kumareswaran *et al* [13] in 2019 and Balakrishnan, M. and Chandran, K. [14] in 2018.

3.4 Co-Integration between Major Coffee Markets of India

In order to study the market integration of domestic coffee markets, price series of Arabica coffee and Robusta coffee were taken separately and then analysed for the presence of co-integration among them. Market integration is a situation in which the price of a given commodity moves together over a long period of time in different spatially separate markets. When a commodity's price changes, if the price of the products of the same quality present in other markets also changes along with it in the same direction, then the markets are considered to be integrated with each other. The market co-integration is done through the following steps.

3.4.1 Staionarity tests

The standard Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were applied to test the stationarity in Arabica coffee prices. The results, summarized in the Table 7, indicate that the price series exhibit a unit root problem at the level form, as the ADF and PP test statistics are below the 5% critical values, leading to the failure to reject the null hypothesis of a unit root. Consequently, the price series are non-stationary at the level form. However, after taking the first difference, the series became stationary, with the ADF and PP statistics exceeding the 5% critical values, confirming that the series is integrated of order one.

Similar procedure were used to determine stationarity in Robusta coffee prices. The results, presented in the Table 8, show that the price series have a unit root at the level form, as the ADF and PP statistics are below the 5% critical values, indicating non-stationarity. However, after taking the first difference, the series became stationary, with the test statistics exceeding the 5% critical values, confirming that the series is integrated of order one.

3.4.2 Johansen co-integration test

The integration among selected Arabica coffee markets were analysed through applying the Johansen co-integration procedure to the time series monthly price data for years from 2005 to 2020. The results of Johansen co-integration test for the Arabica coffee markets have been presented in the Table 9. Table has been presented, shows the co-integration relationship based on trace statistic and maximum eigenvalue statistic. Unrestricted co-integration rank tests (Trace and Maximum Eigen value) indicated the presence of at least 2 co-integrating equations at 5 percent level of significance for both Arabica and Robusta coffee markets, thus revealing that Arabica coffee markets were having long run equilibrium relationship. These results can be compared with Ashoka et al. [15].

Table 5. Growth and instability in coffee export from India

Source	Particulars	Period I (1991-2005)	Period II (2006-2022)	Overall period (1991-2022)
Export Quantity (Tonnes)	R2	0.75	0.60	0.81
	Coefficient	0.0553	0.0372	0.0354
	P value	0.0000	0.0006	0.0000
	Growth rate	5.69***	3.8***	3.6***
	C.V	25.61	19.76	31.75
	CDVI	13.03	12.87	14.04

Source: Authors' calculations

Table 6. Transitional probability matrix for export of coffee from India to different destinations

Destinations	Italy	Germany	Russia	Belgium	Turkey	Poland	Libya	Indonesia	Malaysia	Jordan	Others
Italy	0.69	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Germany	0.07	0.16	0.00	0.00	0.00	0.00	0.18	0.00	0.03	0.10	0.47
Russian	0.00	0.72	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Belgium	0.00	0.31	0.00	0.00	0.00	0.13	0.12	0.20	0.00	0.25	0.00
Turkey	0.16	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00
Poland	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.15	0.73
Libya	0.12	0.00	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indonesia	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.11	0.20	0.00	0.22
Malaysia	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
Jordan	0.92	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.01	0.00	0.11	0.00	0.00	0.00	0.00	0.03	0.00	0.85

Source: Authors' calculations

Table 7. Stationarity tests for whole price series of Arabica Coffee

Particulars	Series	ADF test			PP test		
		ADF test	P value	Remark	PP test	P value	Remark
Bangalore	Level	-1.6118	0.4745	Non-stationary	-1.5668	0.4976	Non-stationary
	1^{st} difference	-11.3147	0.0000	Stationary	-11.3216	0.0000	Stationary
Chennai	Level	-2.0844	0.2513	Non-stationary	-2.0865	0.2504	Non-stationary
	1^{st} difference	-13.3562	0.0000	Stationary	-13.4325	0.0000	Stationary
Hyderabad	Level	-1.9136	0.3255	Non-stationary	-1.9485	0.3096	Non-stationary
	1^{st} difference	-15.0279	0.0000	Stationary	-14.9717	0.0000	Stationary

Source: Author's computations

Table 8. Stationarity tests for whole price series of robusta Coffee

Particulars	Series	ADF test			PP test		
		ADF test	P value	Remark	PP test	P value	Remark
Bangalore	Level	-2.2507	0.1893	Non-stationary	-2.2679	0.1835	Non-stationary
	1st difference	-11.8358	0.0000	Stationary	-11.8387	0.0000	Stationary
Chennai	Level	-2.2582	0.1868	Non-stationary	-2.2520	0.1889	Non-stationary
	1st difference	-14.4657	0.0000	Stationary	-14.5013	0.0000	Stationary
Hyderabad	Level	-2.0243	0.2763	Non-stationary	-2.3632	0.1537	Non-stationary
	1st difference	-8.5682	0.0000	Stationary	-14.4160	0.0000	Stationary

Source: Author's computations

Table 9. Results co-integration rank test (Trace) and (Maximum Eigenvalue) for coffee markets

	Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	Critical value	P Value	Max Eigen statistics	Critical value	P Value
Arabica coffee markets	None*	0.1911	62.14	29.79	0.0000	39.66	21.13	0.0001
	At most 1*	0.0999	22.47	15.49	0.0038	19.69	14.26	0.0063
	At most 2	0.0147	2.78	3.84	0.0952	2.78	3.84	0.0952
Robusta coffee markets	None*	0.0901	34.29	29.79	0.0142	27.66	21.13	0.0142
	At most 1*	0.0763	16.62	15.49	0.0337	14.84	14.26	0.0404
	At most 2	0.0094	1.78	3.84	0.1820	1.78	3.84	0.1820

Trace test indicates 2 co-integrating markets (s) at the 0.05 level Source: Author's computation
**denotes rejection of the hypothesis at the 0.05 level*
***Mackinnon-Haug-Michelis (1999) p-values*

Table 10. Results of granger causality test for coffee markets

	Markets	Number of observations	Chi. Square statistics	P value	Decision	Causality type
Arabica coffee	Bengaluru-Chennai	187	7.0843	0.0000	Do not Reject	Unidirectional
	Chennai-Bengaluru	187	1.1122	0.3556	Reject	No causality
	Bengaluru-Hyderabad	187	6.4082	0.0000	Do not Reject	Unidirectional
	Hyderabad-Bengaluru	187	1.1279	0.3473	Reject	No causality
	Chennai-Hyderabad	187	2.0726	0.0710	Reject	No causality
	Hyderabad-Chennai	187	6.2696	0.0000	Do not Reject	Unidirectional
Robusta coffee	Bengaluru-Chennai	187	4.8304	0.0004	Do not Reject	Bidirectional
	Chennai-Bengaluru	187	1.6608	0.1464	Reject	No causality
	Bengaluru-Hyderabad	187	4.5948	0.0006	Do not Reject	Bidirectional
	Hyderabad-Bengaluru	187	3.1398	0.0097	Do not Reject	Bidirectional
	Chennai-Hyderabad	187	6.7731	8.E-06	Do not Reject	Bidirectional
	Hyderabad-Chennai	187	3.4960	0.0049	Do not Reject	Bidirectional

Source: Author's computation

3.4.3 Granger causality test

After confirming the integration of the price series, a pair-wise Granger causality test was performed to understand the causal relationships between Arabica and Robusta coffee markets. For Arabica coffee, the results in the table indicate that the Bengaluru market exhibits unidirectional causality in price transmission with the Chennai and Hyderabad markets. The Chennai market shows no causality with either the Bengaluru or Hyderabad markets, while the Hyderabad market displays unidirectional causality with the Chennai market and none with the Bengaluru market. For Robusta coffee, the Bengaluru market shows bidirectional causality in price transmission with both the Chennai and Hyderabad markets. The Chennai market exhibits no causality with Bengaluru but has bidirectional causality with Hyderabad. Similarly, the Hyderabad market demonstrates bidirectional causality with both the Bengaluru and Chennai markets.

4. CONCLUSION

This study provides a comprehensive analysis of India's role in the global coffee industry, focusing on production, exports, market integration, and the dynamics of domestic coffee markets. The findings highlight India's significant position as a coffee producer, yet underscore the challenges in translating this into a leading export share due to substantial domestic consumption. In 2022, global coffee production reached 10.89 million tons, with Brazil, Vietnam, and Indonesia leading the sector. India, contributing 3.1% of global production, ranked eighth globally, reflecting its importance as a coffee-growing nation. However, the country's high domestic consumption limits its export potential, placing it 18th among coffee-exporting countries, despite being a major producer. This disparity emphasizes the unique position of India in the global coffee market, where production does not directly correlate with export dominance. The study also examined the growth and variability of coffee exports from India between 1991 and 2022. The analysis revealed that the highest growth in export quantity occurred during the early years (1991-2005), with a 5.69% annual increase. However, the sector experienced significant fluctuations, influenced by volatile coffee prices in both domestic and international markets. Despite these challenges, India's coffee export market has evolved, with Robusta Cherry emerging as the dominant export product, accounting for 44.35% of total coffee exports in 2022. The negligible share of Roasted Coffee Beans in exports points to a missed opportunity in this segment, which could be explored for future growth. The analysis of market integration through the Johansen co-integration test confirmed long-run equilibrium relationships among domestic coffee markets, both for Arabica and Robusta varieties. The results indicated that these markets are integrated, with price movements in one market influencing others over time. This integration suggests that Indian coffee markets are responsive to changes in each other, contributing to a more cohesive national market structure. Moreover, the Granger causality test revealed complex causal relationships between domestic markets. For Arabica coffee, the Bengaluru market demonstrated unidirectional causality with the Chennai and Hyderabad markets, while for Robusta coffee, bidirectional causality was observed between Bengaluru, Chennai, and Hyderabad markets. These findings suggest that price transmission in Indian coffee markets is not uniform and varies between different types of coffee and regional markets.

In conclusion, while India holds a prominent position in global coffee production, its export potential is constrained by domestic consumption and market dynamics. The paper highlights the need for strategic interventions to enhance productivity, particularly in the face of biotic and abiotic stressors, and to explore opportunities in underdeveloped segments like Roasted Coffee Beans. Strengthening export strategies and addressing domestic market integration could further solidify India's role in the global coffee economy, balancing its dual role as a major producer and a significant consumer.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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