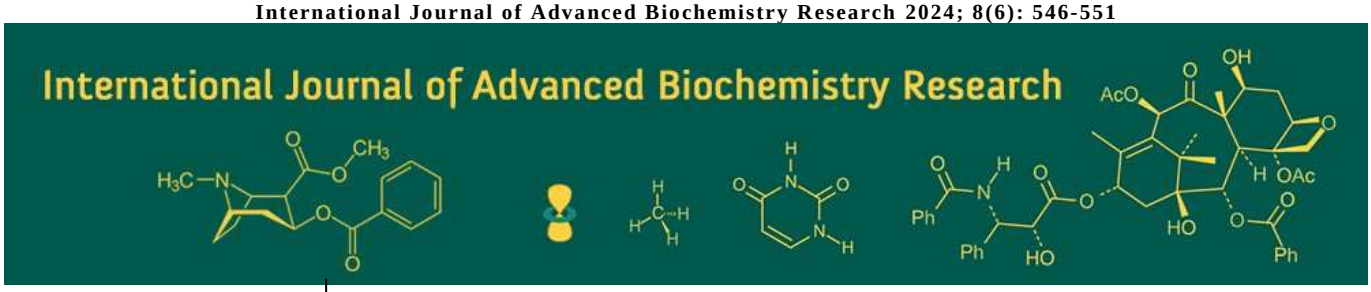

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(6): 546-551
www.biochemjournal.com
Received: 14-03-2024
Accepted: 20-05-2024

Neha Joshi
ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi, India

Anil Kumar
Department of Agricultural Economics, G. B. Pant University of Agriculture and Technology Pantnagar, Uttarakhand, India

Corresponding Author:
Neha Joshi
ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi, India

Navigating growth and instability: Analyzing the dynamics of India's basmati rice exports

Neha Joshi and Anil Kumar

DOI: https://doi.org/10.33545/26174693.2024.v8.i6g.1361

Abstract
India is the leading exporter of basmati rice in the international market. This research explores the details of India's basmati rice exports, examining the impact of policy and economic factors on export value. Using time series data from 1980 to 2022 obtained from the Economic Survey of India and the Ministry of Commerce, the study employs statistical methods to analyze export trends. The research identifies structural breaks to divide the period into sub-periods for assessing growth and instability. By applying multiple linear regression, the study identifies the key factors that influence export value. The findings indicate significant variations in growth rates across sub-periods of 12.30 percent and 35.63 percent respectively. Factors such as production, export price, and exchange rate play crucial roles in the value of basmati rice export. Further, the results also highlight the adverse impact of trade openness on India's basmati rice trade. The Government must take initiative to establish and also ensure proper monitoring of export zones for basmati rice.

Keywords: Agricultural exports, basmati rice, structural break, instability, OLS

Introduction
India's economy is deeply rooted in agriculture, with the sector contributing approximately 17 percent to the total GDP and employing around 58 percent of the population. The importance of agriculture is evident, as over 70 percent of rural households rely on it. In the fiscal year 2021-22, the Gross Value Added (GVA) by the agriculture and allied sector was reported at 18.8 percent, reflecting its significant economic contribution. The agriculture sector has experienced an average annual growth rate of 4.6 percent over the past six years, with a 3.0 percent growth in 2021-22, indicating positive development as per the Economic Survey for 2022-23. The government, recognizing the sector's potential, has implemented various measures to enhance agriculture, such as promoting farmer-producer organizations, encouraging crop diversification, and supporting mechanization and the Agriculture Infrastructure Fund. These measures have contributed to the sector's performance and instilled optimism for its future.

Over the years, Indian agriculture has undergone significant changes since the Green Revolution. A remarkable increase in agricultural production has led to a substantial rise in the country's agricultural exports. For instance, agricultural exports have surged from Rs. 6012.76 crore in 1990-91 to Rs. 305469 crores in 2020-21, marking a nearly 50-fold increase over 30 years. India's transformation from a food-deficient nation to a self-sufficient and even a surplus nation is commendable.

According to the WTO's Trade Statistics 2020 2019, India's share of global agricultural exports and imports was 2.07% and 1.46%, respectively. The share of agricultural exports to total exports witnessed fluctuations over the years, peaking at 20.33% in 1996-97, declining sharply to 9.64% in 2008-09, and eventually reaching 14.20% in 2020-21. Agricultural exports play a vital role in India's agricultural Gross Value Added (GVA), with its share increasing from 3.88% in 1990-91 to 8.45% in 2020-21. In 2021-22, India saw substantial growth in the export of agricultural and allied commodities, reaching US$ 49.6 billion, a 20% increase from US$ 41.3 billion in 2020-21. India is a major exporter of various agricultural products, including rice, wheat, pulses, cashew, sugar, cotton, processed fruits, and vegetables. The primary importers of Indian agricultural products include the USA, Bangladesh, China, UAE, Indonesia, Vietnam, Saudi Arabia, Iran, Nepal, Malaysia, Korea, Japan, Italy, and UK.

In the current financial year 2022-23, India's agricultural and processed food products exports have witnessed a 16% increase over the previous year, reaching US$ 17.43 billion from US$ 15.07 billion. Notably, the export of pulses, basmati rice, poultry products, dairy products, and wheat from India recorded significant growth percentages of 90.49%, 39.26%, 88.45%, 33.77%, and 29.29%, respectively (Ministry of Commerce and Industry, 2020-21). In 2020-21, rice (both basmati and non-basmati) was the largest agricultural export commodity from India, accounting for 21.4 percent of the total agricultural exports. This was followed by marine products (14.5 percent), spices (9.7 percent), buffalo meat (7.7 percent), and sugar (6.8 percent), collectively representing 60.10 percent of all agricultural exports. Rice production is heavily concentrated in Asia, with top producers including China, India, Indonesia, Bangladesh, Vietnam, Myanmar, and Thailand. Globally, rice is grown on 165.25 million hectares, yielding around 515 million tonnes (FAOSTAT, 2021). In India, key rice-producing states are West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, and Bihar, which together account for over 80 percent of the country's production (Thomas and Karunakaran, 2021) [15]. For 2021-22, India's rice production was estimated at 130.29 million tonnes from 46 million hectares, making it the second-largest producer globally, with over 11 percent of global production. India's rice exports constituted more than 19 percent of the country's total agricultural exports in 2021-22. The country produces a diverse range of rice varieties, including parboiled, broken, Sella, Swarna, and Sona Masoori rice. Notably, basmati rice, known for its aroma, long kernels, and sweet taste, is primarily grown in the Himalayan foothills, with Haryana, Uttar Pradesh, Punjab, Jammu and Kashmir, and Uttarakhand being the main production areas (Rangnekar & Kumar, 2010) [13]. The global rice industry is valued at about US$ 275 billion, with the basmati sector alone worth US$ 5.8 billion. India benefits from a cost advantage in agriculture due to low labor costs and self-sufficiency in inputs. Basmati rice, a major export crop, drives India's dominance in the fragrant rice trade. The global basmati rice market was valued at US$ 10,290 million in 2019 and is projected to reach US$ 18,320 million by 2026, with a CAGR of 8.5 percent from 2021-2026. Leading industry players, such as KRBL, Amira Nature Foods, LT Foods, Best Foods, and Kohinoor Rice, operate mainly in India, Pakistan, and Kenya.

India's basmati rice production has been growing steadily, supporting increased exports due to buffer stock availability and rising international demand. The market is expected to grow significantly, with basmati rice consumption estimated to reach 17,613.79 thousand metric tonnes in 2023. However, the agricultural sector faces challenges, particularly in obtaining precise data on domestic production and varietal distribution of basmati rice. This data gap hinders market understanding and potential assessment. With global rice demand rising, it's crucial to improve data collection and analysis to sustain and grow the industry. To maintain its leading position in basmati rice exports, India must evaluate the performance of its basmati rice exports and address both macro and micro determinants affecting them.

Materials and Methods

Data: The research aims to understand the dynamics and performance of India's basmati rice exports, examining how policy and economic interventions impact export value. The methodology includes an analysis of basmati rice export over the years and identification of the key factors influencing these exports.

To meet the research objectives, secondary data was collected primarily from public organization publications. The main sources of data include the Economic Survey of India, Agricultural Statistics at a Glance by the Ministry of Agriculture, the Directorate General of Commercial Intelligence and Statistics website by the Ministry of Commerce, the Reserve Bank of India website for annual exchange rate data, and OECD publications for annual data on India's terms of trade with specific countries.

Analytical framework

To assess the performance of basmati rice exports, growth, and instability were analyzed by examining export data. Initially, structural breaks within the export data were identified, which allowed for the classification of the period into sub-periods. Each sub-period then individually analyzed for growth and instability, in addition to analyzing the entire period as a whole. A structural break refers to an unexpected change in a model's regression parameters, often due to an unforeseen shift in time series data. When such a break occurs, the regression model's parameters do not remain consistent over the entire period. This can result from external factors, significant policy changes, or other causes (Gujarati, 2004) [8].

To determine the structural breaks in the export of basmati rice over the study period, Bai and Perron (1998) [3] test was applied to find multiple breakpoints. This test does not require prior information about the timing of the possible breaks or the number of breaks as it is only based on the data, allowing for correlation and heteroscedasticity.

First a multiple linear regression with *m* breaks in the test is considered as given below:

$$y_t = x_t'\beta + z_t'\delta_j + u_t \quad (1)$$

for $t = T_{j-1} + 1, \cdots, T_j$ and j =1,2,…., m+1

Where m is the number of breaks

y_t is the observed dependent variable i.e., volume and value of basmati rice export

x_t and z_t are vector of covariates and

β and δ_j are the corresponding vectors of coefficients

And u_t the error term at time t, for j =*1,.., m+1*

$T_1, \ldots\ldots, T_m$ are the unknown breakpoints, where T_0 = 0 and T_{m+1} = T

The goal is to find the unknown coefficients for T observations on y_t, x_t and z_t.

These breakpoints constituted the endogenous structural changes based on the time series data and without prior knowledge of economic or policy intervention that occurred during this period. Hence, to attain the subperiods for further analysis of growth and instability in basmati rice export, structural breaks in the series of value of basmati rice export of India were identified using E-views following the equation mentioned above (1).

Compound annual growth rate (CAGR)

Compound annual growth rate is the annualized average growth rate of a variable for a certain period. It depicts the

performance of a particular variable over a significant period. It is worked out to examine the tendency of variables to increase, decrease or stagnate over the period.

To analyze trend in growth of exports, the compound growth rates of basmati rice export(value) was computed for each sub-periods and the overall period, separately. For computing compound annual growth rate, the exponential functional form was preferred over linear, log-linear and power forms, as it was found to perform better over other forms and which has been intermittently employed in studies (Chand and Tiwari, 1991; Adhikari *et al.*, 2016; Ashok *et al.*, 2021) [6, 1, 2]. The following form is used to compute the growth rate in the present study:

$$Y_t = ae^{bt} \quad (1)$$

Where,

Y_t represents volume and value of basmati rice export

a represents intercept

b represents regression or trend coefficient

t represents time variable i.e., year taking values from 1, 2,……,n.

The compound growth rate was obtained from the logarithmic form of the above equation (1) represented as:

$$log\, Y_t = log\, a + bt \quad (2)$$

$$CAGR(\%) = \{Antilog(b) - 1\} \times 100$$

Instability Analysis

Instability is one of the essential decision parameters in development dynamics. An analysis of instability in a variable is crucial for understanding the fluctuations arising in it. Instability in the exports is the year-to-year fluctuation in the variable. The fluctuations can originate from variations in supply and demand and economic and non-economic factors. The analysis of exports was considered necessary to understand the economic instability in the country and globally. Since India is the supreme exporter of basmati rice for global consumers, it is crucial to maintain a stable supply despite the factors causing destabilization.

There are several techniques available to measure the index of instability. Such techniques are found in Coppock (1962) [4], Massel (1970) [12], Singh and Byerlee (1990) [14] and Cuddy and Della Valle (1978) [5]. The instability in the study is estimated using Cuddy-Della Valle Index (CDVI). Though coefficient of variation (CV) is commonly used for estimating the dispersion with comparability across various units, it cannot be used in case of time series data characterized by time trend. Any measure of instability needs to exclude the deviations in the data series that may arise due to secular trend or growth. John Cuddy and Della Valle originally developed CDVI to measure the instability in time series data characterized by trends.

The index was calculated using the following equation:

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

Where,

CV is coefficient of variation;

$\bar{R}^2$, coefficient of determination from time trend regression adjusted by number of degrees of freedom

The value calculated by instability index has been classified into different categories, on the basis of the value it ranges in:

0 -15: Low instability

15-30: Medium instability

> 30: High instability

There are several macroeconomic and microeconomic factors that influence exports of a particular nation. A knowledge about the determinants provides an aid to the policy makers towards optimizing the exports of the country. In the present study the technique of multiple linear regression with Ordinary least squares (OLS) estimation is employed to analyze the quantitative data for the accomplishment of the objective. The value of basmati rice export as the dependent variable and inflation, exchange rate, terms of trade, export price of basmati rice and lagged value of volume of basmati rice exports as dependent variables were included in the model. The selected regression was diagnosed for the classical assumptions based on Gauss Markov theory in order to attain the best linear unbiased estimators. The goodness of fit of the model was met out by employing statistical tests such as t-statistic test, F-statistic test, and coefficient of determination test (Hayashi, 2000) [9].

Estimation procedure: The model estimation in the present study was done through use of Ordinary least squares (OLS) technique using the statistical software E-Views.

Result and Discussion

Assessment of the performance of Basmati rice exports

This section enunciates the comprehensive details about export performance of basmati rice from India under growth, instability and trade direction analysis and identification of determinants influencing them. Dividing the study period into different subperiods via structural break analysis to outline growth and instability and investigation of determinants is outlined in this section. The analysis of export performance began with identification of structural break points endogenously in the series of volume and value of basmati rice exports by employing sequentially determined Bai and Perron test. Structural break analysis scrutinized the unanticipated change in the exports value and volume of basmati rice from India from 1980-81 to 2020-21. This test does not require prior information about the timing of the possible breaks or the number of breaks as it is only based on the data, allowing for correlation and heteroscedasticity.

Two breaks in the value series of basmati rice exports are identified, Table 1 divides the period for growth and stability analysis of the value of exports into three subperiods, *viz*. I (1980-81 to 2005-06), II (2006-07 to 2012-13) and III (2013-14 to 2021-22). The division of the data series into different subperiods is graphically depicted in Fig 1.

Table 1: Structural break points in basmati rice export of India

Break point	Basmati rice export
I	2005-06
II	2012-13

The trend with structural breaks and the identified subperiods for value of basmati rice export is represented in Fig 1.

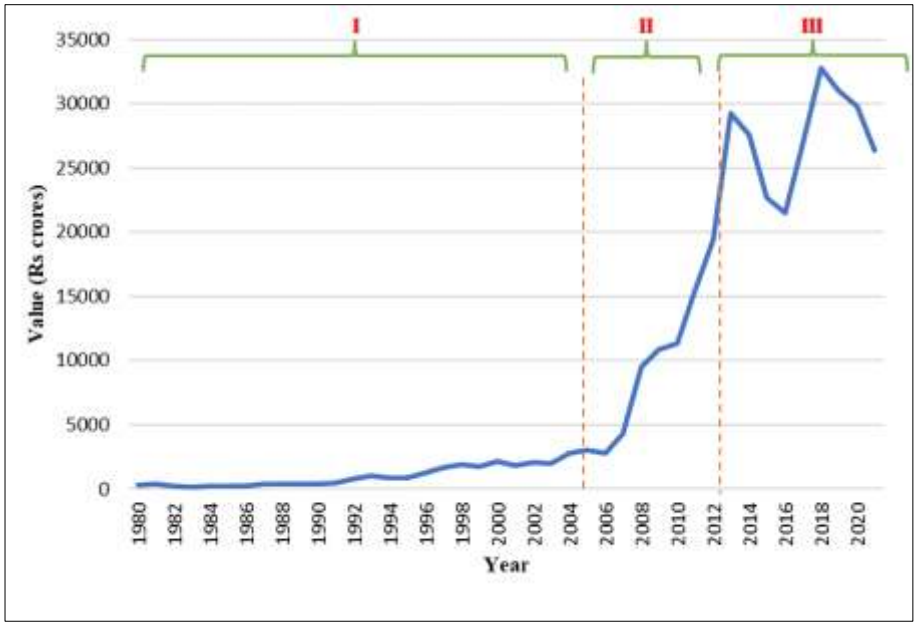

Fig 1: Volume of basmati rice export with identified structural breaks and subperiods

Value derived from export of basmati rice was found highest during 2018-19, though it revealed both the structural breaks before reaching this peak. Both the breaks corresponded to the increase in the value obtained during the previous periods which can be inferred from the significant difference in the growth rates of the corresponding subperiods. During first subperiod export of basmati rice reported the growth rate of 12.30 percent in contrast to a substantially high growth rate of 35.63 percent in the consecutive period which again declines to 1.45 percent during the last subperiod and an overall growth rate of 15.02 percent as presented in Table 2.

Table 2: Growth and Instability in value of basmati rice export

Sub Period	CAGR (%)	Instability	Value of basmati rice export (Rs crores)	
			Initial value	Final value
I (1980-81 to 2005-06)	12.30	30.23	294.73	3043.06
II (2006-07 to 2012-13)	35.63	11.90	2792.80	19409.38
III (2013-14 to 2021-22)	1.45 ^{NS}	13.75	29299.95	26416.53
Overall period	15.02	71.26	294.73	26416.53

^{NS} non-significant values

It registered a consistent increase till 2014. It exhibited the increase of Rs. 3043.06 crores during 2005-06 from Rs. 162.47 crores in 1980-81. The higher positive growth rate was mainly due to the increase in unit value of export driven by higher demand. The value obtained from export of basmati rice revealed a higher growth rate of 35.63 percent during the II subperiod which is the result of highest international prices reported during the period in the global market. Variability in quantity exported from India evident the reported variability in export earnings. The sky-high instability reported in Table 2 in value of basmati rice exports is supported further by wider fluctuations in domestic and international prices and full-fledged competition during the whole period. Several studies reportedly support these arguments (Adhikari *et al.*, 2016; Kumari, *et al.*, 2021) [1, 11].

The index value of 30.23 during I subperiod depicted a higher instability, justified by the wider fluctuations in both domestic and international prices of basmati rice during the subperiod as reported by several reports and studies (Dastagiri *et al.*, 2013; Makama *et al.*, 2016 and Kumari, *et al.*, 2021) [11]. Later on, the variability reduced to its lowest during II subperiod with a value of 11.90, though it gained the momentum after 2012-13. The headwinds that basmati rice industry facing during the period was due to weak demand and oversupply, as reported by a rating agency ICRA. It led to a situation of financial stress for the exporters and its impact was visible in the export earnings during that period.

Factors Influencing Basmati Rice Export of India

Since, all the variables were found non-stationary and serially correlated in their natural form, log transformation of the variables underlined in the model, represented by eq (5) was done in order to get the stationary time series data for further estimation of the coefficients.

*Ln basval = C (0) + C (1) * Ln basvol (-1) + C (2) * Ln exprice + C (3) * Ln exrate + C (4) * Ln inf + C (5) * Ln tot + U*

Where,

Ln basval is log of value of basmati rice export (Rs crore)

*Ln basvol*is log of volume of basmati rice export (Million tonnes)

Ln exprice is log of export price (Rs crore/million tonnes)

Ln exrate is log of exchange rate of India (Rs/$)

Ln inf is log of inflation rate in India (%)

Ln tot is log of terms of trade of India (points)

C (i) are the coefficients of the respective variables in the model

These determinants of volume of basmati rice export from India were analyzed to explain the effect of different micro and macroeconomic variables on the trade flow in the global market. The outcome of the ordinary least square (OLS) regression model is displayed in Table 3.

Table 3: Result of OLS regression model

Ln basval = -1.009328 + 0.815448* Ln basvol (-1) + 0.814925* Ln exprice +0.644385* Ln exrate + 0.215703* Ln inf - 0.968987* Ln tot		
Variable	**Coefficient (Standard error)**	**t-statistic**
LN BASVOL (-1)	0.815448*** (0.088997)	9.162671
LN EXPRICE	0.814925*** (0.198390)	4.107686
LN EXRATE	0.644385*** (0.228460)	2.820560
LN INF	0.215703* (0.124337)	1.734831
LN TOT	-0.968987* (0.562733)	-1.721930
Constant	-1.009328 (1.109917)	-0.909372
Skewness	-0.129502	-
Kurtosis	2.588747	-
Jarque-Bera coefficient and its probability	0.403259	0.817287
R-squared	0.982286	-
Adjusted R-squared	0.979756	-

*10% level of significance
***1% level of significance

All the estimated coefficients from the regression model are significant at the 10 percent level of significance, with the coefficients for lagged volume of basmati rice exports, export price, and exchange rate also being significant at the 1 percent level. The R-squared value indicates that approximately 98.23 percent of the variation in basmati rice export volume is explained by the variables included in the model.

To ensure the robustness of the results and eliminate serial autocorrelation and heteroscedasticity, log transformation of the variables was performed. The normality of the model's residuals was verified using the Jarque-Bera test, as shown in Table 3. Additionally, the stability of the model parameters over the study period was assessed using the cumulative sum of squares of recursive residuals (CUSUM) test, with results presented in Figure 2. The probability value for the Jarque-Bera test statistic was greater than 5 percent, supporting the null hypothesis that the data is normally distributed and confirming the normality of the residuals. The CUSUM test results, with residuals within the 5 percent confidence interval boundaries, confirmed the stability of the model.

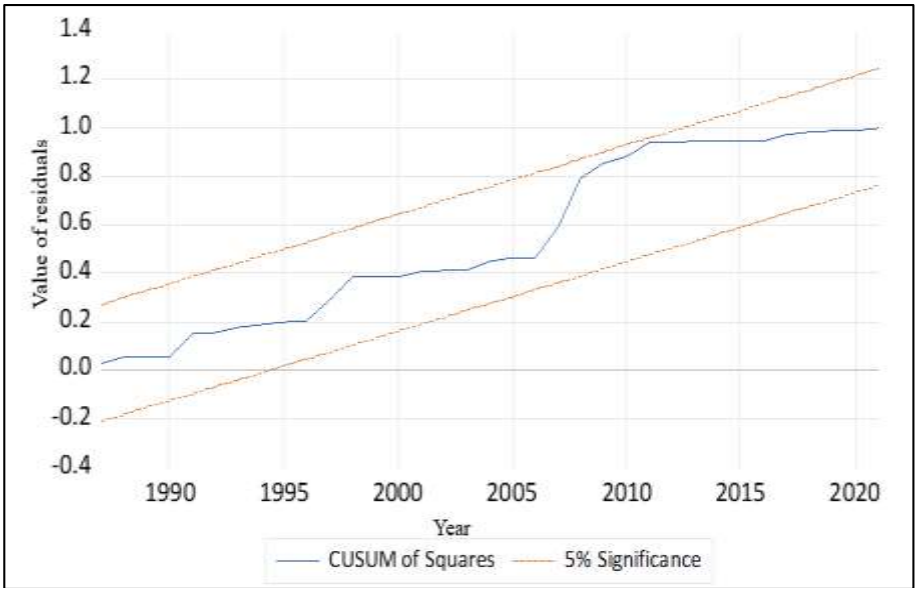

Fig 2: CUSUM test for stability of the model

The analysis reveals a positive correlation between the lagged value of basmati rice export volume, export price, exchange rate, inflation, and the value of exports, while terms of trade show a negative correlation. Key findings regarding significant variables are outlined below.

Lagged volume of basmati rice export: Given that over two-thirds of basmati rice production is exported, the export volume significantly influences the export value. The model's outcome confirms this, showing a positive coefficient of 0.815. This suggests that a 1 percent increase in export volume leads to a 0.815 percent increase in export value in the following year.

Export price: The model indicates that a 1 percent increase in export price results in a 0.815 percent increase in export value. This is logical, as higher prices in the international market enhance foreign earnings from exports.

Exchange rate: The exchange rate between the Rupee and the US Dollar positively impacts the export value of basmati rice. The model's coefficient implies that a 1 percent appreciation in the domestic currency leads to a 0.644 percent increase in export value.

Inflation: Domestic inflation is expected to raise the price of basmati rice, reducing domestic consumption and making more available for export, assuming all other factors remain constant. The model supports this, with a coefficient indicating that a 1 percent increase in inflation increases export volume by 0.216 percent.

Terms of trade: The openness of trade, measured through terms of trade, negatively affects the export value. The model shows that a 1 percent increase in the terms of trade index reduces the export value by 0.969 percent.

The study identifies key determinants of basmati rice export value by analyzing various economic and non-economic factors. The model's adjusted R-squared value of 0.979756 indicates that 97.98 percent of the variation in export value can be explained by the included independent variables. The lagged value of basmati rice production, export price, and exchange rate significantly and positively influence export value at a 1 percent significance level, underscoring their critical role. Inflation significantly impacts export value positively at a 10 percent significance level. Conversely, the terms of trade have a negative and significant effect on export value at a 10 percent significance level, highlighting the adverse impact of trade openness on India's basmati rice trade.

Conclusion

In conclusion, the strategic development of basmati rice production and export is crucial for maintaining and enhancing its competitive edge in the global market. To ensure the sustained growth and competitive advantage of basmati rice in the global market, it is essential to focus on its surplus production, particularly varieties that meet the unique demands of importing nations. A distinct long-term export policy tailored specifically for basmati rice is necessary, as current policies do not differentiate between basmati and non-basmati rice. While basmati rice is sought after internationally for its unique qualities, non-basmati rice exports are driven by higher domestic production. Therefore, targeted policies to boost both the demand and production of basmati rice are crucial. Quality parameters, including pesticide levels, grain size, and aroma, must align with the requirements of each importing nation to ensure the exportability of basmati rice. Additionally, the establishment and proper functioning of export zones dedicated to basmati rice should be a priority to enhance production. Finally, given the sensitivity of basmati rice exports to macro-economic factors such as inflation, terms of trade, and exchange rates, policies should be developed to strengthen macro-economic fundamentals and mitigate external shocks.

References

1. Adhikari A, Sekhon MK, Kaur M. Export of rice from India: Performance and determinants. Agric Econ Res Rev. 2016;29(1):135-150.
2. Ashok KR, Thilagavathi M, Karunakaran KR, Udhayakumar M. State-wise production performance of Basmati and non-Basmati rice in India. Asian J Agric Ext Economics Socio. 2021;39(4):17-31.
3. Bai J, Perron P. Estimating and testing linear models with multiple structural changes. Econometrica. 1998;66(1):47-78.
4. Coppock JD. International economic instability. New York: McGraw-Hill Book Company; c1962. p. 184.
5. Cuddy JD, Valle PD. Measuring the instability of time series data. Oxf Bull Econ Stat. 1978;40(1):79-85.
6. Chand R, Tewari SC. Growth and instability of Indian exports and imports of agricultural commodities. Indian J Agric Econ. 1991;46(2):159-165.
7. Food and Agriculture Organization of the United Nations. FAOSTAT statistical database. Rome; c1997.
8. Gujarati D. Basic econometrics. New Delhi: The McGraw-Hill Publishers; c2004. p. 1027.
9. Hayashi F. Econometrics. Princeton: Princeton University Press; c2000. p. 690.
10. Joshi N, Kumar A. Basmati Rice Exports from INDIA: Towards Global Food Security. Int J Environ Clim Change. 2023;13(8):996-1000.
11. Kumari SS, Perke DS, Kamble AT. Export Competitiveness and Price Trend of Basmati Rice. Econ Aff. 2021;66(04):665-669.
12. Massell B. Export instability and economic structure. Am Econ Rev. 1970;60(4):618-630.
13. Rangnekar D, Kumar S. Another look at Basmati: genericity and the problems of a transborder geographical indication. J World Intellect Prop. 2010;13(2):202-230.
14. Singh AJ, Byerlee D. Relative variability in wheat yields across countries and over time. J Agric Econ. 1990;14(1):21-32.
15. Thomas J, Karunakaran N. Direction of India's rice exports in the post-liberalization era. J Manag Res Anal. 2021;8(3):117-121.