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Growth, Instability, Comparative Advantage and Trade Direction of Sesame Exports from India

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***Abstract*: Sesame (*Sesamum indicum L.*) also known as til, is the oldest indigenous oilseed crop, with longest history of cultivation in India. India ranks first in the world in production with 16.22 lakh ha area and production of 6.67 lakh tonnes and a yield of 405 kg/h in 2019-20. The world average is (535 kg/ha). India and China are the world's largest producers of sesame, followed by Burma, Sudan, Mexico, Nigeria, Venezuela, Turkey, Uganda and Ethiopia. The top exporter of sesame seeds is Sudan followed by India, Nigeria, Myanmar and Tanzania. Top importers are China, Japan, Turkey, South Korea and Iran. Sesame seed production is primarily distributed in the states of Gujarat, West Bengal, Karnataka, Rajasthan, Madhya Pradesh, Maharashtra, Tamil Nadu and Andhra Pradesh. It is the fourth largest oilseed crop cultivated in India. India's contribution to the production of sesame seeds in the world is 20.80 % in 2019-20. Gujarat is the leading sesame producing state contributing 22.3% of total production, followed by West Bengal (19.2%), Karnataka (13.5%), Rajasthan (9.8%), Madhya Pradesh (9.06%).**

***Keywords*: Comparative advantage, Growth, Instability, Oil seeds, Markov chain.**

1. Introduction

Sesame seed is one of the oldest oil seed crops known. Sesame (Sesamum indicum L.), with a global production of 6.01 million tons from an area of 11.74 million hectares (FAOSTAT, 2020), and average yield of 530 kg/ha. is one of the most valued oilseed crops, occupying the seventh position in the edible oil industry (Myint et al., 2020). The most important sesame producing countries are Sudan, Myanmar, Tanzania, India, and Nigeria. India occupies fourth place in production. Regarding area, India ranks first followed by China, Myanmar and Sudan. In the year 2019-20, it recorded an area, production of 1.62 million, Production of 0.65 million tonnes. It is the second largest source of oil seed exports from India and constitutes roughly about 20 % of the total oilseed production and about 35% of oil seed export from the country. Gujarat is the leading sesame producing state contributing 22.3% of total production, followed by West Bengal (19.2%), Karnataka (13.5%), Rajasthan (9.8%), Madhya Pradesh (9.06%).

2. Global Scenario

India is a leader in area of sesame and contributes nearly 9.68 % share in world production and a share of 33 percent in India's oil seed export during 2020-21. Top sesame producing countries in the world are Sudan (22.43 %), Myanmar (10.88 % share) Tanzania (10.44 %) and Nigeria (7.21%). Top exporting nations in the year 2020 are Sudan (20.13%), India (13.11%), Ethiopia (10.80%), Nigeria and Myanmar (8.81%) and (8.75%) shares respectively in terms of sesame export value, in 2020. The top importing nations in the year 2020 are China (33.97%), Japan (8.88 %), Turkey (7.91%), India and south Korea (4.97%) and (3.47 %) shares respectively in terms of imports.

3. Methodology

The study was based on secondary data. The secondary data on sesame export in terms of quantity and value compiled from CMIE, and FAO website study period was from 2001-2020.

Markov chain: The export trade directions have been analyzed using the first-order Markov chain approach. Central to Markov chain analysis by the estimation of the transitional probability matrix P. The elements P_{ij} of the matrix P indicates the probability that export will switch from country 'i' to country 'j' with time. The diagonal elements of the matrix measure the probability that the export share of a country is retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports. In the context of the current application, structural changes are treated as a random process. Mandanna, Sreenivasa Murthy D. and Bisht have employed Markov Chain analysis for studying shifts in the direction of trade with selected eight importing regional countries. The average exports to a particular regional country are considered to be a random variable which depends only on the past exports to that regional country, which can be denoted algebraically as:

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

Where $_{Ejt}$ = Exports from India to the j^{th} country during the year 't'.

- $_{Edit-1}$ = Exports to the ith country during the period t-1.
- $_{Pij}$ = Probability that the exports will shift from ith country to j^{th} country.
- $_{ejt}$ = The error term which is statistically independent of Eit-1.

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- t = Number of years considered for the analysis
- r = Number of importing countries.

The transitional probabilities Pij which can be arranged in a (c * r) matrix have the following properties.

$$O \leq Pij \leq 1$$

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

In the present study, the direction of trade and the changes in exports are examined by employing the first-order Markov chain model. There was a growing awareness of the usefulness of this technique for analysis and forecasting in many fields including exports. Markov chain analysis was used to analyze the structural change in the trade pattern in a system whose progress can be measured in terms of a single outcome variable. Transitional probabilities were obtained by using the data of export quantity during the latest ten years' data. To obtain the TPM, the top seven importing countries were chosen based on their quantity of exports from 2010 to 2020 and the remaining countries' quantity of export was added up to put in 'others'. TPM was estimated using a linear programming framework by a method referred to as minimization of Mean Absolute Deviation. The probability matrix is estimated using linear programming (LP) framework by a method referred to as minimization of mean absolute deviation (MAD).

A. Exponential Growth Model

Compound growth rates were estimated by using log-linear functions on the yearly time series data of the quantity, value and unit value of the exports of the selected oil seeds. The trend was fitted for the respective entire study period of each selected commodity.

For computing, the compound growth rate, the following form of exponential function was used

The CAGR was calculated by fitting the exponential function given below:

$$Y = ab^t u_t$$

Where,

Y = Area, production, yield and price of commodity consider in year t

a = intercept

u_t = Error term

b = Regression coefficient

t = Time variable

The equation obtained after transforming (i) is:

$\text{Log } y = \log a + t \log b + \log u_t$

The percent CAGR was calculated as:

$$CAGR = [(\text{antilog of } b) - 1] \times 100$$

The significant CAGRs will be classified into two groups i.e., negative and positive CAGR. The significance of the growth rate were analyzed by conducting a student's t-test at 1 per cent and 5 per cent levels of significance.

B. Instability Index

The instability index will be analyzed by using the Cuddy Della Valle Index method developed by John Cuddy and Della Valle for measuring the instability in time series data (Cuddy and Della Valle, 1978). This index is inherently adjusted for trend, so is considered a better measure than the Coefficient of Variation. As CV overestimates the level of instability in time-series data, which is characterized by long term trends. Cuddy-Della Valle index corrects the coefficient of variation.

$$\text{Instability index} = \frac{Standard\ Deviation}{Mean} \times \sqrt{1 - \bar{R}^2}$$

Where,

C- D II = Instability Index

CV = Coefficient of variation

$\bar{R}^2$ = Coefficient of determination from a time-trend regression adjusted for its degree of freedom.

When the test statistic is significant, then the Cuddy- Della index is calculated by using the $\bar{R}^2$ value. The high degree of instability index shows that there were huge fluctuations in the time series data during the study period. The high growth and low instability are prerequisites for sustainable agricultural performance. Since the magnitude of growth and instability in crops, production has serious implications for policymakers.

Revealed comparative advantage:

The revealed competitive advantage of a nation is measured by the relative weight of a percentage of the total export of commodity in a nation over the percentage of world export in that commodity.

Formula Given by Balassa (1965)

$$\text{Revealed Comparative Advantage} = B = (X_{ij}/x_{it})/(x_{nj}/x_{nt})$$

Where x represents exports, i is a country (India), j is a commodity (sesame), t is a set of commodities and n is a set of countries. B is based on observed trade patterns. It measures a country's exports of a commodity relative to its total exports and to the corresponding export performance of a set of countries, e.g., the EU. If B > 1, then a comparative advantage is revealed.

If the RCA takes the value greater than unity i.e., RCA> 1, that means India has a comparative advantage in exports of sesame. If the value is less than one i.e., RCA<1 then exports of sesame do not have a comparative advantage or having comparative disadvantage for India.

4. Result and Discussion

Growth rate and Instability:

Growth rate and instability of sesame exports to major

importing countries have been presented in Table 1. It was found that exporting to all the major destinations, recorded mixed responses with some countries showing positive value and some showing negative value. In terms of quantity Iran recorded the highest growth rate with (20.28 per cent) followed by UAE, Australia, UK, Malaysia and USA with values of 5.38 per cent, 4.87 per cent, 3.91 per cent, 2.46 per cent and 1.73 per cent, respectively.

In terms of the value of exports, all major destinations recorded positive growth with Iran showing 32.08 per cent growth followed by UAE, Australia, UK, Malaysia, USA, Taiwan, Netherlands and Singapore with values of 13.84 per cent, 13.03 per cent, 12.06 per cent, 10.25 per cent,10.61 per cent, 8.68 per cent and 7.66 per cent, 6.46 per cent respectively. Mexico recorded the lowest growth rate with 0.34 per cent in terms of value.

With respect to instability values of cuddy Della index USA recorded medium instability both in terms of export quantity and value. Malaysia recorded low instability in terms of export quantity and recorded medium instability in terms of value of exports. Countries like UK and Taiwan recorded medium instability both in terms of quantity and value of exports respectively. Netherlands recorded medium instability in terms of export value and rest of the nations recorded high instability values both in terms of quantity and value of exports. This indicate that India should try to export more with use of various agreements in foreign trade with nations like USA, Malaysia and UK.

With regard to the result of growth and instability of Sesame exports countries like USA, Malaysia, Singapore and Taiwan recorded low instability and low growth which is not preferred in exporting of commodities. Mexico recorded high instability and low growth while that of UK recorded low instability and high growth in export off commodities which is the most preferred way while exporting commodities. UAE and Australia recorded less instability in value of export and high instability index and growth rate which is not preferred. Singapore recorded low instability and low growth with significance in export value. Iran recorded less instability in import value and it showed high instability in growth and quantity of exports.

Destinational changes in export of Sesame from India:

Regarding the direction of trade of sesame to different countries and to study the loyalty in the exports of Sesame, Markov-chain analysis was employed using the time-series data from 2010 to 2020. Mandanna, Sreenivasa Murthy, D. and Bisht, have employed Markov Chain analysis for studying shifts in the direction of trade. The transitional probabilities depicted in the Table 2 indicate that other countries recorded highest retention of Indian sesame with 67.10 per cent, followed by Netherlands with 46.0 per cent retention followed by Iran (41.1 per cent), Korea (25.7 per cent), USA (23.3 per cent) and Vietnam (17.3 per cent). Vietnam has shown a retention of 17.30 per cent and it gained 84.60 per cent from Russia and 17.70 per cent from other countries. Vietnam lost to the tune of 32.3 per cent to others, 17.9 per cent to Iran and 12.7 per cent to Russia where as it gained from Russia (84.6 per cent) and others (17.7 per cent). Korea has a retention of 25.70 per cent and it lost 21.40 per cent share to USA, 52.90 per cent to other countries. It gained 14.90 per cent share from other countries. USA is having a retention of 23.30 per cent and it lost its share of 29.40 per cent to Greece and 47.30 per cent to other countries. Russia has shown no retention and Netherlands and Iran has shown a retention of 46 per cent and 41.10 per cent, respectively.

Revealed Comparative Advantage:

From table 3, we can infer that India has a Comparative Advantage in sesame export because the values of RCA are

Table 1
Growth and Instability of Sesame exports from India

Country	CAGR (%)		Instability (%)	
	Export quantity	Export value	Export quantity	Export value
Iran	20.28 **	32.08 **	40.12	39.34
UAE	5.38 *	13.84 **	50.82	41.68
Australia	4.87 *	13.03 **	72.59	39.25
UK	3.91 **	12.06 **	19.40	27.89
Malaysia	2.46 **	10.25 *	12.25	21.74
USA	1.73 **	10.61 **	15.68	21.04
Taiwan	-0.33 NS	8.68 **	23.56	28.73
Netherlands	-0.46 NS	7.66 **	69.39	21.48
Singapore	-2.79 NS	6.46 **	35.14	42.17
Mexico	-6.61 **	0.34 NS	40.75	139.05
** significant at 1% level * significant at 5 % level				

Source: CMIE

Table 2
Transitional probability of sesame exports from India

Countries	Vietnam	Korea	USA	Russia	Netherlands	Iran	Greece	Others
Vietnam	0.173	0.001	0.107	0.127	0.028	0.179	0.062	0.323
Korea	0.000	0.257	0.214	0.000	0.000	0.00	0.000	0.529
USA	0.000	0.000	0.233	0.000	0.000	0.00	0.294	0.473
Russia	0.846	0.000	0.000	0.000	0.000	0.076	0.000	0.078
Netherlands	0.000	0.000	0.386	0.006	0.46	0.000	0.148	0.000
Iran	0.000	0.000	0.000	0.389	0.20	0.411	0.000	0.000
Greece	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
Others	0.177	0.149	0.000	0.003	0.022	0.003	0.005	0.641

Source: Researchers own compilation

greater than 1 during study period from 2001-2020. The above-mentioned result highlights that India maintained Comparative advantage throughout the study period in sesame export. The findings of RCA indicate that Indian sesame exports had a revealed comparative advantage during the study period. The table indicates that India is losing its comparative advantage of sesame exports during 2011-12, 2014-15 and its share has reduced to 11.36 per cent in 2019-20 from the highest of 17.05 per cent share in 2002-03.

Table 3
Revealed comparative advantage of sesame

Year	RCA
2001-02	16.04
2002-03	17.05
2003-04	14.61
2004-05	17.01
2005-06	14.15
2006-07	16.36
2007-08	10.89
2008-09	13.45
2009-10	13.71
2010-11	10.13
2011-12	9.97
2012-13	10.79
2013-14	11.45
2014-15	9.55
2015-16	10.56
2016-17	11.76
2017-18	10.82
2018-19	11.33
2019-20	11.36

Source: Authors calculation

5. Conclusion

India ranks first in the world in production of sesame with 16.22 lakh ha area and production of 6.67 lakh tonnes and a yield of 405 kg/h in 2019-20. The world average is (535 kg/ha). India and China are the world's largest producers of sesame, followed by Burma, Sudan, Mexico, Nigeria, Venezuela, Turkey, Uganda and Ethiopia. The top exporter of sesame seeds is Sudan followed by India, Nigeria, Myanmar and Tanzania. Top importers are China, Japan, Turkey, South Korea and Iran. Sesame seed production is primarily distributed in the states of Gujarat, West Bengal, Karnataka, Rajasthan, Madhya Pradesh, Maharashtra, Tamil Nadu and Andhra Pradesh. The findings of RCA indicate that Indian sesame exports had a revealed comparative advantage during the study period

The comparative advantage of sesame exports during 2011-12, 2014-15 has reduced and has a reduced share of 11.36 per cent in 2019-20 from the highest of 17.05 per cent share in 2002-03.

The result of Markov chain indicated that Netherlands was the most reliable and loyal market for Indian sesame with 46.0 per cent retention.

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