Export dynamics of oilseed in India: A Markov Chain Analysis

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Abstract:

This study analyses the export trends of India's oilseeds to major importing countries from 2011 to 2022 using first-order Markov Chain Analysis. The data was entirely secondary collected information from Ministry of Commerce and Industry. The study aims to understand the dynamics and directions of oilseed exports by examining transitional probability matrices. The analysis reveals strategic diversification in export patterns, with significant export relationships between the USA and Australia, the UK distributing exports across the USA, Canada, and Brazil, and Spain exporting broadly to the UK, Brazil, and other destinations. Brazil focuses on Italy and the USA, while Italy targets Brazil and Spain. Australia's main partners are Brazil and the UK, and Canada concentrates on Spain and Brazil. Other countries primarily export to Canada and Italy. The value analysis underscores the importance of these trade relationships, highlighting the critical roles of Spain and Brazil. The findings suggest that India's diversified export strategy mitigates market dependency risks and enhances trade stability, offering valuable insights for future export trends and strategic planning in the global oilseed market.

Keywords: Export, markov chain, transition probability matrix, stability, oilseed.

Introduction

Oilseeds are seeds grown primarily for the production of edible oils. The diverse agro-ecological conditions in the country are favorable for growing 9 annual oilseed crops, which include 7 edible oilseeds (groundnut, rapeseed & mustard, soybean, sunflower, sesame, safflower and niger) and two non-edible oilseeds (castor and linseed) (Umar, 2015).

Oilseed crops are the second most important determinant of agricultural economy, next only to cereals within the segment of field crops. The self-sufficiency in oilseeds attained through "Yellow Revolution" during early 1990's, could not be sustained beyond a short period. Despite being the fifth largest oilseed crop producing country in the world, India

is also one of the largest importers of vegetable oils today. There is a spurt in the vegetable oil consumption in recent years in respect of both edible as well as industrial usages (Jha*et al.,* 2006; Lokapur*et al.,* 2014).

Oilseed crops are a valuable source of energy, with energy content ranging between 141 and 598 Kcal/kJ. They are essential for all metabolic processes and can supplement or replace animal products, which are inadequate to meet the needs of an increasing world population. The nutritional importance of oilseed crops is numerous, and they are a valuable source of energy, polyunsaturated fats, and protein (Pandey *et al.,* 2005).

In India, oilseed crops account for 13% of the gross cropped area, 3% of the gross national product, and 10% of the value of all agricultural commodities. The oilseed sector in India has recorded annual growth rates of area, production, and yield of 2.44%, 5.47%, and 2.96%, respectively, during the last decade. The diverse agro-ecological conditions in India are favorable for growing nine annual oilseed crops, including groundnut, rapeseed & mustard, soybean, sunflower, sesame, safflower, niger, castor, and linseed.

India is the largest producer of oilseeds in the world and the oilseeds sector occupies an important position in the country's economy, fourth largest after USA, China and Brazil. The country accounts for 12-15 percent of global oilseeds area, 6-7 percent of vegetable oils production, and 9-10 percent of the total edible oils consumption. In terms of acreage, production and economic value, oilseeds are second only to food grains. (IBEF,2022).

The Oilseeds sector has been one of the most dynamic components of world agriculture in the past three decades growing at 4.1% per annum surpassing the growth of agriculture and live stock products. The performance of oilseeds on the domestic front during the last two decades has been commendable braving the vagaries of weather conditions, the global price aberrations and the ever increasing domestic demand (GOI, 2023).

The production of oilseeds in India has been growing for the last five years. In 2020-21, the production of the country was 365.65 lakh ton which was a 10% increase from that of the previous year. India's total oilseeds production in the market year (MY) 2021/22 (October-September) is forecast to rise four percent to 39.9 million metric tons (MMT), based on expectations of near normal oilseeds crop yields. The anticipated rise in oilseeds supply will increase meal production by two percent to 18.8 MMT, leaving approximately 2.9 MMT for exports after accounting for domestic consumption. Concurrently, vegetable oil imports will rise marginally by one percent to 14.5 MMT to fill the consumption gap (Uma *et al.,* 2021). Inthis background, with the help of models, wetried to find out direction and dimension of trade in India.

Materials and Methods

Period of study

The time series data is taken from 2011 to 2022 of oilseed for seven majorimportingcountries.

Natureandsources ofdata:

The time series data on pulse exports to major importing countries were collected from secondary sources. Specifically, these data were obtained from the Ministry of Commerce and Industry.

Analytical Framework:

The trade directions of pulse (export) were analysed usingthe first order Markov Chain Analysis. The estimate of the transitional probability matrix P is a basic component of Markov Chain Analysis. The chance that exports will eventually shift from nation "i" to country "j" is indicated by the components P_{ij} of the matrix P. The likelihood that a nation's export share would be maintained is shown by the diagonal members of the matrix. Stated differently, the importing country's level of allegiance to a certain country's exports may be determined by analyzing the diagonal components of the transitional probability matrix.

The row parts show the likelihood of trade loss due to rival nations, while the column elements show the likelihood of trade gain from other rival nations (Verma *et al.,* 2024).

Markovchainanalysis

$$E_{jt} = \sum_{i=1} E_{it-1} P_{ij} + e_{jt} \qquad \dots\dots\dots(1)$$

Where,

E_{jt} = export from India to the jth country in the year t,

E_{jt-1}= exports of ith country during the year t-1,

P_{ij}=probabilitythatexportswere shiftfromi^{th}countrytoj^{th}country

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

n = thenumberofimportingcountriesand

 t= numberofyearsconsideredfortheanalysis

ThetransitionalprobabilitiesP_{ij}whichcanbearrangedina(c*r)matrixhavethefollowingproperties.

0≤Pij≤1,

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

Thus, the expected export share of each country during period 't' is obtained by multiplying the export to these countries in the previous period (t-1) with the transitional probability matrix (Srivastava *et al.,* 2023).

Results and Discussion

Direction of oilseeds export in quantity from India (2011 to 2022)

The table 1. revealedthe distribution of respondents across various response categories for different countries, including the USA, UK, Spain, Brazil, Italy, Australia, Canada, and Others. The values in the table represent the proportion of respondents from each country who selected a particular response category

The export trends of oilseeds from India between 2011 and 2022 reveal distinct patterns across various countries. The USA primarily exported oilseeds to Australia (90.61) and a smaller share to other countries (9.05). The UK's major export partners were the USA (38.68), Canada (20.55), Brazil (16.30), and other countries (9.94). Spain had diversified its exports, sending significant portions to the UK (16.66%), Brazil (16.72), and other destinations (20.88). Brazil's exports were heavily oriented towards Italy (43.26), followed by the USA (38.37). Italy exported mainly to Brazil (20.03), Spain (18.79), and the USA (17.36), with a notable portion to Australia (15.30). Australia's key export destinations were Brazil (41.58), the UK (35.57), and Spain (13.14). Canada's export focus was on Spain (47.98) and Brazil (37.45). Other countries predominantly exported to Canada (47.85) and Italy (20.56). These trends highlight the diverse and strategic export directions for Indian oilseeds, reflecting varying market demands and trade relations across different regions.

Table 1:- Transition probability matrix of oilseeds export in quantity from India (2011 to 2022)

S.No	USA	UK	Spain	Brazil	Italy	Australia	Canada	Others
USA	0.0000	0.0000	0.0000	0.0000	0.0000	0.9061	0.0000	0.0905
UK	0.3868	0.0000	0.0603	0.1630	0.0861	0.0994	0.2055	0.0000

Spain	0.1157	0.1666	0.1553	0.1672	0.0000	0.0000	0.1859	0.2088
Brazil	0.3837	0.0000	0.0881	0.0911	0.4326	0.0000	0.0000	0.0000
Italy	0.1316	0.1879	0.1736	0.2003	0.0000	0.1530	0.1514	0.0000
Australia	0.0000	0.3557	0.1314	0.4158	0.0000	0.0000	0.0962	0.0000
Canada	0.0000	0.1431	0.4798	0.3745	0.0000	0.0000	0.0000	0.0000
Others	0.0000	0.2944	0.0000	0.0261	0.2056	0.0000	0.4785	0.0000

Fig 1:- Directional Graph of oilseeds export in Quantity from India
Direction of oilseeds export in value from India (2011 to 2022)
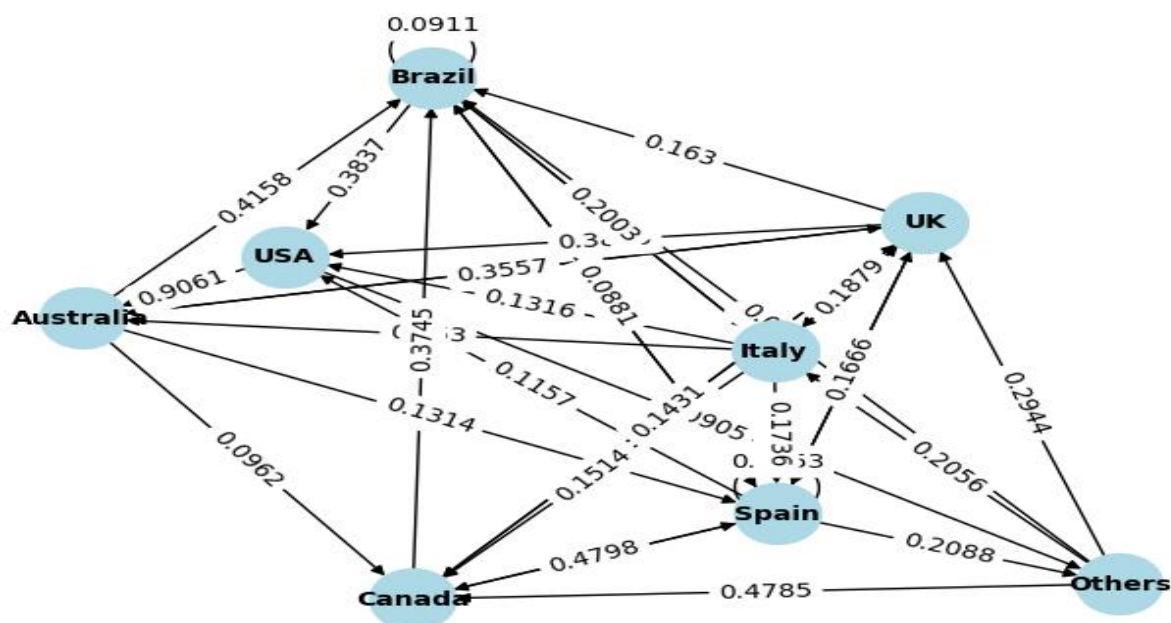
The table 2 provided in the question illustrates the direction of oilseeds export in quantity from India to various countries, including the USA, UK, Spain, Brazil, Italy, Australia, Canada, and Others. The direction of oilseeds export in value from India to various countries between 2011 and 2022 shows a diverse distribution across major trading partners. The USA, although receiving no exports from the UK and Brazil, accounted for a significant share from Australia (74.36) and Spain (15.64). The UK, while receiving 10 of its oilseeds from itself, sourced 32.25 from Canada, followed by 18.23 from other countries, 15.68 from Australia, and smaller shares from Spain and Italy. Spain had notable contributions from Brazil (21.61), Canada (27.45), and other countries (36.78), indicating a broad import base. Brazil's exports were predominantly directed to the USA (57.86), with smaller proportions to the UK and Spain, and a significant share (16.65) to Australia. Italy's imports were diversified, with

significant portions coming from the USA (45.59), Canada (21.28), and other countries (12.28).

Australia had a significant export proportion to Canada (37.52) and the USA (39.59), with smaller shares to Italy and other countries. Canada's imports showed a significant share from Brazil (30.30), followed by contributions from the UK, Spain, and the USA. Other countries had a diverse import base, with substantial contributions from Spain (26.01), Italy (34.70), and smaller shares from Brazil and Canada. Overall, the data highlights the diverse and dynamic nature of India's oilseeds export market, with varying levels of dependence on different countries over the 2011 to 2022 period.

Table 2:- Direction of oilseeds export in value from India (2011 to 2022)

| C. No.	USA	UK	Spain	Brazil	Italy	Australia	Canada	Others
USA	0.0000	0.0000	0.1564	0.0000	0.0000	0.7436	0.0000	0.1023
UK	0.0000	0.1000	0.1161	0.0000	0.1235	0.1568	0.3225	0.1823
Spain	0.0000	0.0000	0.0000	0.2161	0.0000	0.1399	0.2745	0.3678
Brazil	0.5786	0.1013	0.1536	0.0000	0.0000	0.1665	0.0000	0.0000
Italy	0.4559	0.0000	0.0693	0.0633	0.0845	0.1128	0.2128	0.0000
Australia	0.3959	0.0000	0.0000	0.0000	0.0957	0.0000	0.3752	0.1307
Canada	0.3155	0.1094	0.1882	0.3030	0.0865	0.0000	0.0000	0.0000
Others	0.0000	0.0653	0.2601	0.1563	0.3470	0.0000	0.1753	0.0000
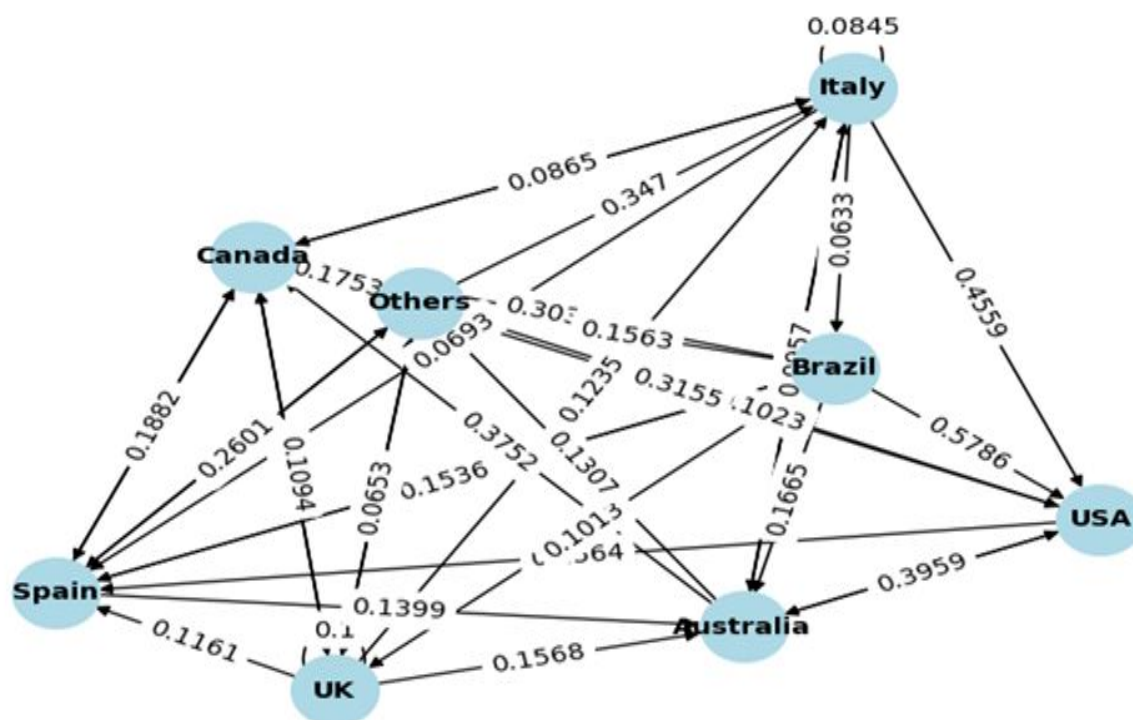
Fig 2:- Directional Graph of oilseeds export in Value from India

Conclusion

According to the above discussion, reveals significant patterns of strategic diversification. The USA primarily exports to Australia (90.61%), while the UK diversifies across the USA, Canada, and Brazil. Spain's exports are spread across the UK, Brazil, and other destinations. Brazil focuses on Italy and the USA, while Italy targets Brazil and Spain. Australia's key partners are Brazil and the UK, with substantial exports to Spain. Canada concentrates on Spain and Brazil, and other countries primarily export to Canada and Italy. In terms of export value, the USA imports significantly from Australia and Spain, and the UK has varied sources. Spain and Brazil play critical roles in the export landscape. This diversification reduces dependency risks and enhances trade stability. Markov Chain Analysis provides insights into transitional probabilities and trade dynamics, strengthening India's global oilseed market position.

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