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Palm oil imports in India: A data-driven analysis of trade patterns and policy implications

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Abstract

Palm oil plays a crucial role in India's edible oil economy due to its affordability, wide industrial use, and increasing demand from the food processing sector. However, domestic palm oil production remains limited, resulting in a heavy reliance on imports. This study examines long-term trends in India's palm oil imports, production patterns, and tariff dynamics using secondary time-series data. Descriptive statistics, the Mann-Kendall trend test, Sen's slope estimator, and price index analysis were applied to evaluate structural changes in the sector. The results reveal a strong and statistically significant upward trend in palm oil imports between 1964 and 2024, while domestic production has grown slowly and remains unstable. Tariff policy adjustments have influenced short-term import patterns but have not significantly reduced overall import dependence. Price index analysis shows a consistent increase in import prices over time, indicating strong transmission of global price movements to the domestic market. The findings suggest that India's dependence on palm oil imports is structural and cannot be resolved through tariff interventions alone. Strengthening domestic oil palm cultivation, improving supply chain infrastructure, and diversifying import sources are essential for long-term edible oil security.

Keywords: Palm oil imports, India, tariff policy, trend analysis, price index, edible oil trade

1. Introduction

Edible oils play a crucial role in ensuring food security and nutritional balance in many developing countries. Among the various edible oils consumed worldwide, palm oil has gained particular importance due to its high productivity, relatively low cost of production, and wide range of industrial applications. Palm oil is extracted from the fruit of the oil palm tree (*Elaeis guineensis*), which is primarily cultivated in tropical regions. Over the past few decades, palm oil has become one of the most widely traded agricultural commodities in the world. Its versatility and economic advantages have made it a dominant component in global vegetable oil markets.

In India, palm oil has emerged as the most widely consumed edible oil due to several economic and practical advantages. Compared with other edible oils such as soybean oil, sunflower oil, and groundnut oil, palm oil is relatively cheaper and more readily available in international markets. Its long shelf life, neutral taste, and suitability for various cooking methods have made it popular among households and food processing industries. In addition to its use in cooking, palm oil is widely used in the manufacturing of processed foods, bakery products, confectionery items, cosmetics, soaps, detergents, and biofuels. These diverse applications have significantly contributed to the increasing demand for palm oil in India.

The rapid growth of population, rising income levels, urbanization, and changing dietary patterns have further

accelerated the demand for edible oils in the country. As consumers increasingly shift toward processed and packaged food products, the demand for palm oil has expanded rapidly because it serves as a key ingredient in many processed food items. The expansion of the food processing industry, fast-food chains, and retail markets has also played a significant role in increasing palm oil consumption in India.

Despite the rising demand for edible oils, domestic production has not been able to keep pace with consumption requirements. India has historically relied on oilseed crops such as groundnut, mustard, soybean, and sunflower for edible oil production. However, productivity levels of these crops remain relatively low compared to global standards due to factors such as limited irrigation facilities, small landholdings, and technological constraints. As a result, domestic edible oil production has been insufficient to meet the rapidly growing demand.

Recognizing the potential of oil palm cultivation to improve edible oil self-sufficiency, the Government of India has introduced several initiatives aimed at promoting oil palm farming in suitable agro-climatic regions. Programs such as the Oil Palm Development Programme and the National Mission on Edible Oils – Oil Palm (NMEO-OP) have been launched to encourage farmers to cultivate oil palm through financial incentives, subsidies, and technical support. These initiatives aim to expand the area under oil palm cultivation and increase domestic production over time.

However, despite these policy efforts, domestic palm oil production in India remains relatively limited. Oil palm cultivation requires specific climatic conditions, adequate irrigation facilities, and long gestation periods before plantations become productive. These factors have slowed the expansion of oil palm cultivation in the country. Consequently, domestic production continues to fall far short of the growing consumption requirements.

As a result of this supply-demand gap, India has become one of the largest importers of palm oil in the world. A significant portion of India's palm oil imports comes from major producing countries such as Indonesia and Malaysia, which dominate global palm oil production and export markets. These imports play a critical role in ensuring the availability of edible oil in the domestic market and stabilizing consumer prices.

However, heavy dependence on imports also exposes India to several risks and challenges. Global palm oil prices are subject to fluctuations due to factors such as weather conditions, production levels in exporting countries, international trade policies, and changes in global demand. Additionally, export restrictions or policy changes in major producing countries can significantly affect the availability and price of palm oil in the Indian market.

Another important factor influencing palm oil imports in India is the government's tariff policy. Import duties on crude and refined palm oil have been adjusted periodically to balance the interests of consumers and domestic producers. Lower tariffs help reduce the cost of edible oils for consumers but may discourage domestic oilseed production. Conversely, higher tariffs can support domestic producers but may increase food prices. Therefore, understanding the relationship between tariff changes and import patterns is essential for evaluating the effectiveness of government policies.

Given the economic significance of palm oil in India's edible oil sector, it is important to analyze the long-term trends in imports, domestic production, and policy interventions. Studying these trends provides valuable insights into the structural dynamics of the edible oil market and helps policymakers formulate strategies to improve edible oil security and reduce excessive dependence on imports.

The present study aims to analyze the long-term trends in palm oil imports and production in India using historical data. In addition, the study examines how changes in import tariffs and global price movements influence import behavior over time. By applying statistical techniques such as descriptive analysis, growth rate analysis, and trend analysis, the study seeks to provide a comprehensive understanding of the evolution of the palm oil sector in India.

The findings of this study are expected to contribute to the existing literature on agricultural trade and edible oil markets while also offering policy insights for improving domestic production and ensuring a stable supply of edible oils in the country.

2. Data and Methodology

Data Sources

The study uses secondary time-series data collected from multiple reliable sources, including FAOSTAT, the

Directorate General of Commercial Intelligence and Statistics (DGCIS), the Ministry of Agriculture, and international trade databases. The dataset covers:

- Palm oil imports (1964–2024)
- Palm oil production in India (1991–2024)
- Tariff rates on crude and refined palm oil (2001–2023)

These datasets form the empirical basis for the analysis.

Analytical Methods

This study employs several quantitative analytical techniques to examine trends in palm oil imports, production, tariff policies, and price movements in India. The methods include descriptive statistics, growth rate analysis, the Mann–Kendall trend test, Sen's slope estimator, and price index analysis. These methods help identify patterns, variability, and long-term trends in the data.

1. Descriptive Statistical Analysis

Descriptive statistics are used to summarize and describe the main characteristics of the dataset. This method helps in understanding the general behavior of palm oil imports and production in India over the study period.

The key descriptive statistical measures used in the study include:

Mean (Average)

The mean represents the average value of the dataset over the study period.

$$\bar{X} = \frac{\sum X}{N}$$

Where

- X = individual observation
- N = total number of observations

The mean provides an overall estimate of the typical level of imports or production during the study period.

Standard Deviation

Standard deviation measures the dispersion or variability of the data around the mean.

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{N}}$$

A higher standard deviation indicates greater fluctuations in the data.

Coefficient of Variation (CV)

The coefficient of variation measures relative variability and allows comparison of variation across datasets.

$$CV = \left(\frac{SD}{Mean} \right) \times 100$$

If the CV value is high, it indicates that the data has high variability or instability.

In this study, CV helps evaluate whether palm oil imports or

production fluctuate significantly over time.

Average Growth Rate

The average growth rate measures the rate at which imports or production increase over time.

$$\text{Growth Rate} = \frac{(\text{Current Value} - \text{Previous Value})}{\text{Previous Value}} \times 100$$

This indicator helps determine whether the import or production levels are increasing or decreasing over the years.

2. Mann-Kendall Trend Test

The Mann-Kendall test is a non-parametric statistical method used to identify trends in time-series data. It is widely used in economic, environmental, and agricultural studies to detect increasing or decreasing trends.

This test does not require the data to follow a normal distribution and is therefore suitable for long-term economic datasets such as import and production data.

The Mann-Kendall test evaluates whether there is a monotonic trend (consistently increasing or decreasing trend) in the data over time.

Steps in the Mann-Kendall Test

1. Each observation is compared with all subsequent observations.
2. The number of positive and negative differences is calculated.
3. A statistic called S is computed.

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^n \text{sign}(X_j - X_i)$$

Where:

- X_j = later data value
- X_i = earlier data value

The sign function is defined as:

- +1 if $X_j - X_i > 0$
- 0 if $X_j - X_i = 0$
- -1 if $X_j - X_i < 0$

Z Statistic

The Mann-Kendall test converts the S statistic into a standardized Z value to determine statistical significance.

Interpretation:

- $Z > 0 \rightarrow$ increasing trend
- $Z < 0 \rightarrow$ decreasing trend
- $Z \approx 0 \rightarrow$ no trend

If the p-value is less than 0.05, the trend is statistically significant.

3. Sen's Slope Estimator

Sen's slope estimator is used along with the Mann-Kendall test to determine the magnitude of the trend.

While the Mann-Kendall test identifies whether a trend exists, Sen's slope estimates how much the variable changes per year.

The slope is calculated as:

$$Q = \frac{X_j - X_i}{j - i}$$

Where:

- X_j = later observation
- X_i = earlier observation
- $j - i$ = time difference between observations

All slope values are calculated and the median of these slopes is taken as the Sen's slope estimator.

Interpretation:

- Positive slope $\rightarrow$ increasing trend
- Negative slope $\rightarrow$ decreasing trend

For example, if Sen's slope is 166, it means imports increase by about 166 units per year on average.

4. Price Index Analysis

A price index is used to measure changes in the price level of palm oil imports over time. It helps determine whether import prices are increasing or decreasing relative to a base year.

In this study, a base year index method is used.

Price Index Formula

$$\text{Price Index} = \left(\frac{\text{Price in Current Year}}{\text{Price in Base Year}} \right) \times 100$$

Where:

- Base year index = 100
- Values above 100 indicate price increase
- Values below 100 indicate price decrease

For example:

If the base year price = 630 USD/MT and the current year price = 830 USD/MT,

$$\text{Price Index} = \frac{830}{630} \times 100 = 131.7$$

This means prices increased by about 31.7% compared to the base year.

Trend Interpretation

The combination of the above methods allows a comprehensive analysis of the palm oil sector in India.

- Descriptive statistics explain the variability in imports and production.
- Growth rate analysis shows how fast the sector is expanding.
- Mann-Kendall test identifies long-term trends.
- Sen's slope estimator measures the rate of change in the trend.
- Price index analysis evaluates the impact of price fluctuations on imports.

Together, these methods provide a robust statistical framework for analysing the dynamics of palm oil trade and production in India.

Table 1: Palm Oil Import Data (1964–2024)

Year	Imports (Thousand MT)
1964	7
1975	298
1985	798
1995	970
2005	2217
2010	5584
2015	8857
2020	8411
2022	10045
2024	9400

This table presents the long-term trend in palm oil imports to India from 1964 to 2024. The data clearly show a significant increase in import volumes over time. In the early years, imports were extremely low, but they increased rapidly after the 1990s due to rising population, increasing demand for edible oils, and trade liberalization policies. By 2022, imports reached more than 10 million tonnes, indicating a strong dependence on imported palm oil.

Table 2: Palm Oil Production in India (1991–2024)

Year	Production (Thousand MT)
1991	5
2000	40
2010	79
2015	219
2018	279
2022	305
2024	305

This table shows the growth of palm oil production in India over the years. Production started at very low levels in the early 1990s and gradually increased due to government initiatives promoting oil palm cultivation. However, despite this growth, domestic production remains extremely small compared to import volumes. This indicates that India still relies heavily on imports to meet its edible oil demand.

Table 3: Palm Oil Tariff Data (2001–2023)

Year	Crude Palm Oil Tariff (%)	Refined Palm Oil Tariff (%)
2001	65	75
2005	50	55
2010	32.5	37.5
2015	15	20
2020	45	50
2023	15	20

This table shows the changes in import tariffs on palm oil over time. Initially, tariffs were very high to protect domestic producers. However, the government gradually reduced tariffs to ensure affordable edible oil prices for consumers. In some years, tariffs were increased again to support domestic oilseed farmers. These fluctuations reflect the government’s efforts to balance consumer affordability with producer protection.

Table 4: Descriptive Statistics of Import Data

Statistic	Value
Mean	3097
Standard Deviation	3478
Coefficient of Variation (%)	112.31
Average Growth Rate (%)	1.08

This table summarizes the statistical characteristics of palm oil import data. The mean indicates that average imports during the study period were around 3097 thousand metric tonnes. The high standard deviation and coefficient of variation suggest significant fluctuations in import volumes over time. The average growth rate indicates a gradual increase in imports over the study period.

Table 5: Mann–Kendall Trend Test for Imports

Observations	Z-value	Kendall’s Tau	Sen’s Slope	p-value
59	9.116	0.816	166.64	<0.001

This table presents the results of the Mann–Kendall trend test for palm oil imports. The positive Z-value indicates a strong increasing trend in imports. The very small p-value shows that the trend is statistically significant. The Sen’s slope value indicates that imports increased by approximately 166 thousand tonnes per year on average.

Table 6: Descriptive Statistics of Production Data

Statistic	Value
Mean	118.88
Standard Deviation	109.79
Coefficient of Variation (%)	92.36
Average Growth Rate (%)	0.148

This table summarizes the statistical properties of palm oil production in India. The relatively low mean production value compared to imports highlights the limited scale of domestic production. The high coefficient of variation suggests fluctuations in production levels due to climatic conditions, cultivation challenges, and policy factors.

Table 7: Mann–Kendall Trend Test for Production

Observations	Z-value	Kendall’s Tau	Sen’s Slope	p-value
34	7.548	0.926	9.83	<0.001

This table shows the trend analysis for palm oil production. The positive Z-value and significant p-value indicate a statistically significant increasing trend in production. However, the Sen’s slope value is relatively small, which means production is increasing slowly compared to the rapid growth in imports.

Table 8: Price Index of Palm Oil Imports

Year	Price (USD/MT)	Price Index
2001	450	71.43
2005	530	84.13
2010	630	100
2015	730	115.87
2020	830	131.75
2023	890	141.27

This table shows the changes in palm oil import prices over time using a price index with 2010 as the base year. The index values indicate that palm oil prices have increased steadily over the years. This reflects global market dynamics such as supply shortages, increased demand, and biofuel policies. Rising prices have significant implications for India’s import expenditure and food inflation.

Conclusion

This study examined long-term trends in palm oil imports,

production, and tariff policies in India using descriptive statistics, trend analysis, and price index methods. The results indicate a strong and statistically significant upward trend in palm oil imports over the study period. Domestic production has increased but remains insufficient to meet demand. Tariff adjustments have influenced short-term import behavior but have not significantly reduced dependence on imports.

The findings suggest that India's palm oil import dependence is structural in nature. Therefore, policy efforts should focus on expanding domestic oil palm cultivation, improving agricultural productivity, and strengthening supply chains. Diversifying import sources and adopting stable trade policies can also help reduce vulnerability to global market shocks.

Policy Implications and Recommendations

The findings of the study reveal a significant and continuous increase in palm oil imports in India over the past several decades. At the same time, domestic production has increased only moderately, resulting in a widening gap between demand and supply. Based on these findings, several policy implications and recommendations can be drawn to improve India's edible oil sector and reduce excessive dependence on imports.

1. Expansion of Domestic Oil Palm Cultivation

One of the most important policy measures required is the expansion of domestic oil palm cultivation. The study shows that despite gradual growth in production; domestic output remains extremely small compared to imports. Therefore, the government should promote oil palm cultivation in suitable agro-climatic regions such as Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, and the northeastern states.

This can be achieved through:

- Providing financial incentives and subsidies to farmers
- Expanding irrigation infrastructure
- Offering high-yielding oil palm seedlings
- Strengthening agricultural extension services

Increasing domestic cultivation will help reduce reliance on imported palm oil and improve national edible oil security.

2. Strengthening the National Mission on Edible Oils

The government has launched the National Mission on Edible Oils – Oil Palm (NMEO-OP) to increase domestic palm oil production. However, the implementation of this program needs to be strengthened through improved coordination between central and state governments.

Policy measures should include:

- Increasing budget allocations for oil palm development programs
- Providing guaranteed purchase agreements for farmers
- Supporting processing and storage infrastructure

Effective implementation of this mission can significantly boost domestic palm oil production in the long run.

3. Balanced Import Tariff Policy

The analysis shows that tariff policies have fluctuated significantly over the years. While lower tariffs help control

consumer prices, they can discourage domestic production by making imports cheaper.

Therefore, the government should adopt a balanced tariff policy that protects domestic farmers while maintaining affordable prices for consumers. A stable and predictable tariff structure will help both producers and importers plan their activities more effectively.

4. Diversification of Import Sources

India currently relies heavily on a small number of countries, particularly Indonesia and Malaysia, for palm oil imports. This high dependence increases vulnerability to supply disruptions and price volatility.

To reduce this risk, India should diversify its import sources by strengthening trade relations with other palm oil producing countries such as:

- Thailand
- Colombia
- Guatemala
- African palm oil producing nations

Diversification will enhance supply security and reduce the risk associated with dependence on a limited number of suppliers.

5. Promotion of Alternative Edible Oils

Another important policy recommendation is the promotion of alternative edible oils such as soybean oil, sunflower oil, mustard oil, and groundnut oil. Encouraging the production and consumption of these oils can reduce the excessive dependence on palm oil imports.

This can be achieved through:

- Providing incentives for oilseed farmers
- Supporting research on high-yield oilseed varieties
- Promoting awareness about diversified edible oil consumption

Increasing the production of alternative edible oils will contribute to a more balanced and resilient edible oil sector.

6. Improvement of Supply Chain and Processing Infrastructure

Efficient processing, storage, and transportation infrastructure are essential for improving the competitiveness of domestic palm oil production. Investments should be made in modern oil extraction plants, storage facilities, and logistics systems.

Improved infrastructure will reduce post-harvest losses and enhance the profitability of palm oil cultivation for farmers.

7. Strengthening Market Information Systems

Farmers often lack access to timely information regarding prices, market demand, and government policies. Developing a strong agricultural market information system will enable farmers to make better production and marketing decisions.

Digital platforms and mobile-based advisory services can play an important role in disseminating information related to palm oil cultivation and marketing.

Conclusion

The present study examined the trends and patterns of palm

oil imports, domestic production, tariff policies, and price movements in India over an extended period. The analysis revealed several important findings regarding the structure and dynamics of the palm oil sector in the country.

The results indicate that palm oil imports in India have increased significantly over the past several decades. The Mann–Kendall trend test confirmed a strong and statistically significant upward trend in import volumes. The Sen's slope estimator further indicated a consistent annual increase in imports. This trend reflects the growing demand for edible oils driven by population growth, urbanization, and changing dietary habits.

At the same time, domestic palm oil production has also shown a positive trend, although the rate of increase is relatively small compared to imports. Despite government initiatives to promote oil palm cultivation, domestic production remains insufficient to meet the rapidly increasing demand for edible oils.

The descriptive statistical analysis revealed high variability in import volumes and production levels, suggesting that the palm oil sector is influenced by multiple factors such as global market conditions, domestic demand, government policies, and climatic conditions.

The analysis of tariff policies indicates that the government has frequently adjusted import duties to balance consumer interests and producer protection. However, these tariff changes have not significantly altered the long-term trend of increasing imports. The price index analysis further shows that global palm oil prices have increased steadily over time. Despite rising prices, India continues to import large quantities of palm oil due to strong domestic demand and limited domestic supply.

Overall, the study highlights the structural dependence of India on imported palm oil. While imports play an important role in ensuring adequate edible oil supply, excessive dependence on imports exposes the country to global price volatility and supply disruptions.

Therefore, long-term strategies aimed at expanding domestic production, promoting alternative edible oils, and improving supply chain infrastructure are essential to enhance India's edible oil security.

Future Research

Although the present study provides valuable insights into the trends and determinants of palm oil imports and production in India, several areas remain open for further research.

First, future studies could examine the impact of palm oil imports on domestic oilseed farmers and agricultural income. Understanding how imports influence farmer livelihoods would help policymakers design more balanced trade policies.

Second, further research could focus on the environmental implications of expanding oil palm cultivation in India. Oil palm plantations require specific climatic and ecological conditions, and large-scale expansion may have environmental consequences that need careful evaluation.

Third, future studies could analyze the relationship between global palm oil prices and domestic edible oil inflation in India using advanced econometric models such as vector autoregression (VAR) or cointegration analysis.

Fourth, research could also explore the role of technological

innovations and improved crop varieties in increasing the productivity of oil palm cultivation in India.

Finally, comparative studies between India and other major palm oil consuming countries could provide useful insights into best practices for achieving a more sustainable and efficient edible oil sector. Further research in these areas will contribute to a deeper understanding of the palm oil industry and support the development of more effective policies for ensuring long-term edible oil security in India.

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