# THE DYNAMICS OF THE GLOBAL PALM OIL AND SOYBEAN OIL ECONOMY IN MAJOR PRODUCING COUNTRIES

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**Abstract**

This study analyzes the economic dynamics of palm oil and soybean oil in major producing countries within the global vegetable oil market. The increasing global demand for vegetable oils has intensified production expansion, trade flows, and price fluctuations, particularly in countries that dominate world supply. This research aims to describe and examine trends in production, exports, and international prices of palm oil and soybean oil in the main producing countries over the period 1995–2024. The study employs a quantitative descriptive approach using time-series and comparative analysis based on secondary data from international statistical sources. The findings indicate that both commodities demonstrate strong long-term growth in production and export volumes, although characterized by significant price volatility driven by global demand shifts, trade policies, and external economic shocks. Palm oil production is highly concentrated in Southeast Asia, while soybean oil production is more geographically diversified. Despite fluctuations, both commodities remain strategic drivers of export revenue and agricultural sector growth in producing countries. The study concludes that the global vegetable oil market exhibits sustained expansion accompanied by structural vulnerabilities, requiring adaptive economic strategies to maintain stability and competitiveness.

Keywords: Palm oil, Soybean oil, Economic dynamics, Global trade, Major producing countries

## INTRODUCTION

The global vegetable oil market has undergone rapid structural transformation over the past three decades, driven by population growth, income expansion, urbanization, and industrial demand. Among the various vegetable oils traded internationally, palm oil and soybean oil account for the largest share of global production and consumption. The (OECD/FAO, 2022) reports that these two commodities together contribute more than half of total world vegetable oil output, highlighting their strategic importance in global food systems and agricultural trade. Their dominance has positioned major producing countries as key actors in determining global supply stability and price movements.

Palm oil production is geographically concentrated, particularly in Indonesia and Malaysia, while soybean oil production is more diversified across the United States, Brazil, and Argentina. This structural difference creates distinct market characteristics in terms of supply elasticity, trade orientation, and price responsiveness. According to the (Bank, 2021), vegetable oil prices have experienced significant fluctuations over the last decade due to supply chain disruptions, climate variability, and geopolitical tensions. These dynamics underline the importance of examining production growth, export trends, and price volatility in an integrated framework.

In this study, economic dynamics refer to temporal changes in production levels, export volumes, and international price movements that reflect the structural evolution of the sector. Production dynamics capture changes in output driven by technological adoption, land expansion, and productivity improvements. Trade dynamics reflect shifts

in comparative advantage and global market integration, while price dynamics indicate market sensitivity to global shocks. Understanding these interrelated components is essential for analyzing how major producing countries sustain competitiveness in a volatile global environment.

Empirical data illustrate the dominance of specific countries in global production. Indonesia and Malaysia consistently lead palm oil output, while the United States and Brazil dominate soybean oil production. The comparative structure of global production is presented in Table 1.

**Table 1.** Estimated Production of Palm Oil and Soybean Oil in Major Producing Countries (Million Tons, 2023)

| Commodity | Country | Production (Million Tons) |
|---|---|---|
| Palm Oil | Indonesia | 46,5 |
| Palm Oil | Malaysia | 18,8 |
| Soybean Oil | United States | 12,0 |
| Soybean Oil | Brazil | 10,9 |

Source: (Nations, 2024)

The data demonstrate a high concentration ratio in palm oil production compared to soybean oil. Such concentration increases exposure to regional shocks, including climate disturbances and domestic policy shifts. Conversely, soybean oil's relatively diversified production base provides greater resilience to localized disruptions. This structural distinction contributes to differences in global market stability and price transmission mechanisms.

Export performance further reflects the strategic role of these commodities in national economies. Palm oil exports represent a significant share of agricultural export earnings in Indonesia and Malaysia, while soybean oil exports are closely integrated with soybean complex trade flows in the Americas(UNDP, 2023)) indicates that global vegetable oil trade volumes have grown steadily since the early 2000s, reinforcing the sector's contribution to foreign exchange earnings and rural economic development.

Price volatility constitutes another crucial dimension of economic dynamics. International vegetable oil prices surged sharply during the global food crisis and again during recent geopolitical disruptions. (World Bank, 2020) reports that price indices for vegetable oils increased substantially between 2020 and 2022 before moderating in subsequent years. Such fluctuations influence producer income, investment decisions, and global food affordability. Therefore, examining long-term price trends is essential to understand cyclical and structural patterns in the market.

Despite the strategic importance of these commodities, comparative analyses focusing specifically on the long-term economic dynamics of both palm oil and soybean oil across major producing countries remain limited. Most studies emphasize environmental or policy aspects rather than integrated economic trajectories. This research addresses that gap by systematically describing and analyzing production growth, export expansion, and price movements of palm oil and soybean oil in major producing countries during 1995–2024. By employing a quantitative descriptive approach based on international secondary data, this study seeks to provide a comprehensive understanding of the structural evolution of the global vegetable oil market and its implications for economic competitiveness.

## RESEARCH METHOD

This study employs a quantitative descriptive research design to analyze the economic dynamics of palm oil and soybean oil in major producing countries. A descriptive approach is appropriate because the objective is to systematically examine patterns of production, export performance, and international price movements over time without testing causal relationships. Quantitative analysis enables the identification of long-term trends, structural shifts, and comparative performance across countries using measurable macroeconomic indicators (Creswell & Creswell, 2023).

The population of this study consists of all countries producing palm oil and soybean oil globally. However, the sample were determined using a purposive sampling method (Mubarokah et al., 2024; Marliyah et al., 2025; Ogari et al., 2026). the sample is purposively limited to major producing countries that consistently account for the largest share of global output. For palm oil, Indonesia and Malaysia are selected, while for soybean oil, the United States and Brazil are included. The selection is based on their dominant contribution to global production and export volumes as reported by international statistical agencies (FAO, 2023).

The period of analysis covers 1995–2024 to capture long-term structural dynamics and cyclical fluctuations in the global vegetable oil market. This time frame allows observation of major economic events, including commodity price booms, global financial crises, and recent supply chain disruptions. The research is conducted through secondary data collection using international databases, ensuring cross-country comparability and consistency of measurement standards (*World Bank Open Data*, 2025).

The main variables analyzed in this study include annual production volume measured in metric tons, export volume and value measured in international trade statistics, and international price indicators expressed in United States dollars per metric ton. Economic dynamics are operationally defined as temporal changes and fluctuations in these variables over the observation period. Production dynamics reflect output growth trends, trade dynamics represent export expansion and competitiveness, and price dynamics indicate volatility and market sensitivity. The data used in this study consists of secondary data, data was obtained from business reports, production documents, publications, and scientific literature relevant to the research (Sugiyono, 2021; Mukhlis et al., 2022; Mukhlis et al., 2023). Data are obtained from several authoritative international sources, including the Food and Agriculture Organization, the World Bank Commodity Price Data, and the United Nations Conference on Trade and Development statistical database. These institutions provide standardized and internationally recognized datasets, which enhance the reliability and validity of cross-country economic comparisons.

The research procedure begins with data compilation and verification to ensure completeness and consistency across years and countries. The data are then organized into time-series format and grouped by commodity and country. Cleaning procedures are conducted to address missing values and outliers. After validation, the dataset is processed using statistical software to generate descriptive statistics, growth rates, and graphical trend analysis. Analytical techniques include trend analysis, growth rate calculation, and comparative analysis between commodities and countries. Trend analysis is applied to identify long-term movements in production and exports, while annual growth rates are calculated to assess the speed of expansion. Price volatility is examined using standard deviation and coefficient of variation to measure fluctuations over time

(Gujarati & Porter, 2020). Comparative analysis is used to evaluate structural differences between palm oil and soybean oil markets.

To ensure methodological rigor, the study adheres to principles of transparency, data consistency, and replicability. The use of internationally standardized data reduces measurement bias and enhances comparability across countries. By integrating production, trade, and price indicators within a unified analytical framework, the method provides a systematic basis for understanding the economic dynamics of palm oil and soybean oil in major producing countries over an extended period.

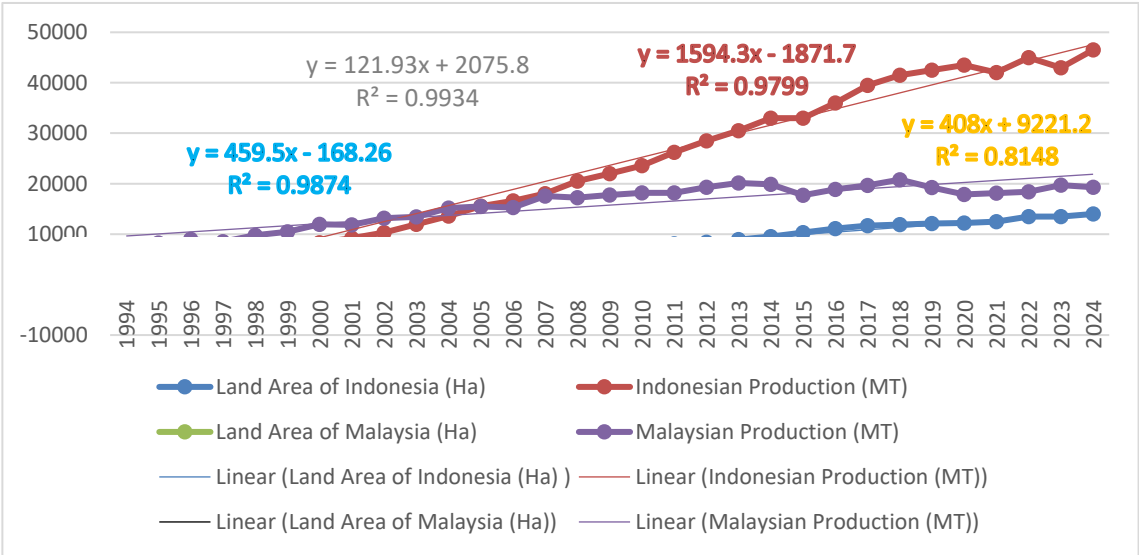
## RESULT AND DISCUSSION

### *Development of CPO Vegetable Oil in Major Producing Countries*

### *Area and Production of CPO of Major Producing Countries*

Crude Palm Oil (CPO) is one of the most important vegetable oil commodities globally, playing a strategic role in meeting world demand for edible oils, bioenergy, and industrial raw materials. Global palm oil production is heavily concentrated in Indonesia and Malaysia, which together account for more than 80 percent of total world output. Indonesia has become the largest producer, driven by continuous expansion of plantation areas particularly in Sumatra and Kalimantan accompanied by substantial growth in production and export capacity.

Malaysia ranks second, maintaining high productivity levels despite having a relatively smaller plantation area. Its competitiveness is supported by efficient plantation management and advanced cultivation technologies. Other countries such as Thailand, Nigeria, and Colombia also contribute to global palm oil supply, although their production volumes remain significantly lower than those of the two leading producers (Gaol, 2018). The expansion of plantation areas and production in major producing countries has been largely driven by rising global demand for food, biodiesel, and downstream industrial products. However, rapid land expansion has raised environmental concerns, placing sustainability at the center of international palm oil trade discussions.




Source: Index Mundi, 2025 (processed)

**Figure 1.** Development of Palm Oil Areas and Production in Indonesia and Malaysia in 1994-2024

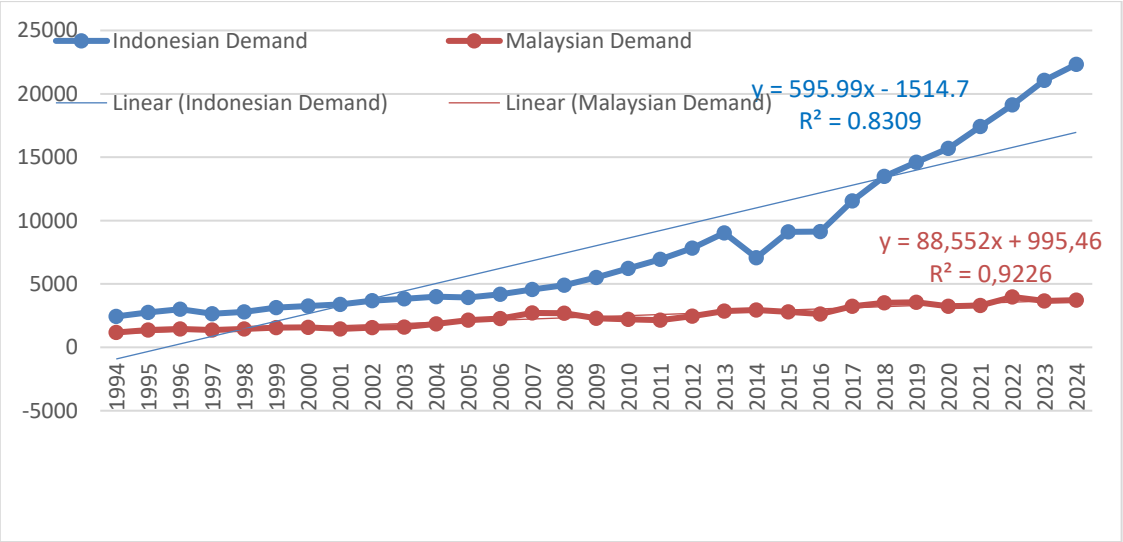
Figure 1 illustrates the expansion of oil palm plantation area and CPO production in Indonesia and Malaysia from 1994–2024. Both countries show upward trends, but Indonesia's growth has been significantly steeper. In 1994, Indonesia recorded 1.19 million hectares and 4.25 million tons of production, compared to Malaysia's 2.14 million hectares and 7.77 million tons. Rapid expansion in Indonesia accelerated after investment deregulation and the Perkebunan Inti Rakyat (PIR) scheme strengthened smallholder participation (Susila, 2004). Linear trends confirm this divergence: Indonesia's plantation area follows $y = 459.5x - 168.26$ ($R^2 = 0.9874$) and production $y = 1{,}594.3x - 1{,}871.7$ ($R^2 = 0.9799$), while Malaysia shows more moderate growth with area $y = 121.93x + 2{,}075.8$ ($R^2 = 0.9934$) and production $y = 408x + 9{,}221.2$ ($R^2 = 0.8148$), reflecting land constraints and stricter conservation policies (Hidayat & Basir, 2021; Rahmayani et al., 2023)).

After 2005, Indonesia's production surged from 15.56 million tons to 46.5 million tons in 2024, driven by land availability, foreign investment, downstream industrialization, and the Downstream Policy alongside the Mandatory Biodiesel Program (B30) (Pahan, 2020; Syahza et al., 2021). Malaysia's output increased more slowly, reaching about 19.3 million tons in 2024, as policy shifted toward productivity and technological innovation (Basiron, 2019). Since overtaking Malaysia in 2007, Indonesia has maintained global leadership, yet future competitiveness depends on balancing productivity gains with sustainable palm oil standards(Efriansyah et al., 2024).

***CPO Demand from Major Producing Countries***

Demand for Crude Palm Oil (CPO) in major producing countries has continued to increase in line with rising global vegetable oil consumption. Although a significant share of palm oil production is export-oriented, domestic demand in key producers such as Indonesia and Malaysia has also shown consistent growth. This increase is primarily driven by higher consumption of cooking oil, expanding food and cosmetic industries, and the growing use of palm oil as a feedstock for biodiesel.

In Indonesia, domestic demand has been strongly stimulated by the Mandatory Biodiesel Program (B30 and B35), aimed at reducing fossil fuel dependence and enhancing domestic value added. As a result, a larger proportion of national production is absorbed by the domestic market, influencing export supply and international price movements. Malaysia has similarly experienced rising domestic demand, although exports still account for the majority of its production. Other producers, including Thailand and Colombia, have also begun utilizing palm oil for renewable energy and domestic industrial purposes to strengthen national energy security.




Source: Index Mundi, 2025 (Processed)

**Figure 2.** Development of Demand in Indonesia and Malaysia from 1994 to 2024 (1000 MT)

Figure 2 illustrates the evolution of palm oil demand in Indonesia and Malaysia over the period 1994–2024. Both countries exhibit a consistent upward trend, reflecting expanding domestic consumption alongside economic growth, population increase, and the development of palm-based processing industries. However, Indonesia demonstrates a significantly faster growth rate, particularly after the implementation of biofuel-oriented energy policies. The linear trend estimation indicates that Indonesia's demand follows the regression equation $y = 595.99x - 1{,}514.7$ ($R^2 = 0.8309$), while Malaysia's demand follows $y = 88.552x + 995.46$ ($R^2 = 0.9226$), suggesting stable long-term growth patterns in both countries despite differing growth intensities.

In 1994, Indonesia's palm oil demand stood at approximately 2.84 million tons, compared with 2.13 million tons in Malaysia. By 2024, Indonesia's demand had surged to 15.2 million tons, representing an increase of more than 435 percent, largely driven by the Mandatory Biodiesel Program (Pahan, 2020; Mundi, 2025). In contrast, Malaysia's domestic demand rose more moderately to 4.2 million tons, influenced mainly by the expansion of food, oleochemical, and related industries (Basiron, 2019; Hamzah & Santoso, 2020; Ibrahiim & Halkam, 2017).

Overall, the findings highlight Indonesia's dual role as both the largest exporter and a rapidly growing domestic consumer, reshaping the structure of the Southeast Asian palm oil market and influencing global supply dynamics (R. Susila, 2010).

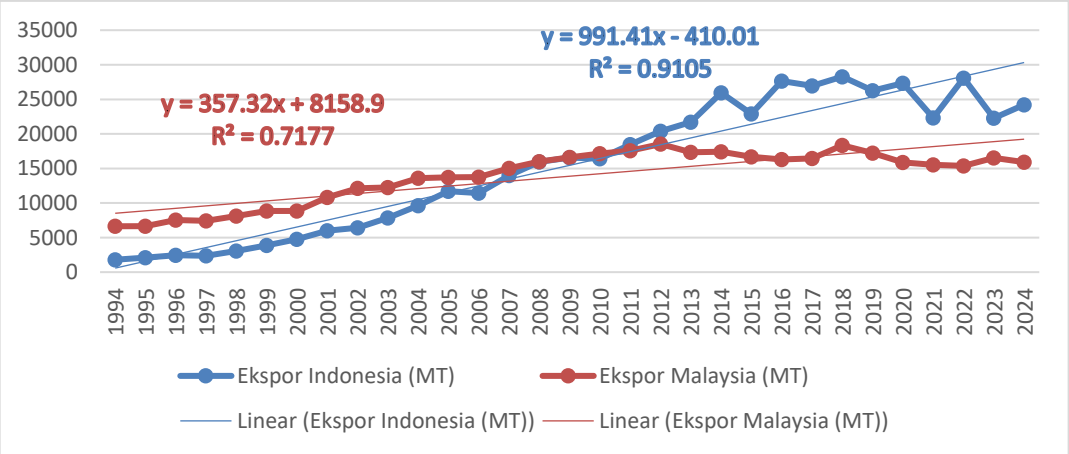
***Palm Oil Exports of Major Producing Countries***

Palm oil exports are a key determinant of performance in major producing countries. Indonesia and Malaysia together account for more than 80 percent of global palm oil export market share. Indonesia ranks first as the world's largest exporter, with most of its production shipped to major destinations such as India, China, Pakistan, and the European Union. Its export performance has continued to grow in line with rising global demand for vegetable oils used in food and renewable energi (Ismail et al., 2017).

Malaysia ranks second in global palm oil exports. Although its production volume is slightly lower than Indonesia's, Malaysia benefits from more established logistics and export infrastructure. The country is also known for higher value-added downstream

products, including olein, stearin, and biodiesel, which strengthen its competitiveness despite fluctuations in crude palm oil prices.

The volume and value of palm oil exports from major producers are strongly influenced by global vegetable oil prices, domestic export policies, and demand from importing countries. Price volatility driven by supply–demand dynamics, sustainability issues, and tariff regulations in destination markets plays a significant role in shaping export performance. Therefore, international palm oil trade not only reflects the competitiveness of producing countries but also signals shifts in global consumption patterns and energy policies.




Source: Index Mundi, 2025 (Processed)

**Figure 3.** CPO Export Volume of Major Producing Countries, 1994-2024

Figure 3 shows the evolution of palm oil export volumes from Indonesia and Malaysia during 1994–2024. Both countries experienced significant upward trends, particularly after the early 2000s, driven by plantation expansion, higher production capacity, and growing global demand for vegetable oils in food and renewable energy. However, Indonesia's growth has been markedly faster, indicating a shift in global export dominance since the mid-2000s. The linear trend confirms this pattern: Indonesia's equation ($y = 991.41x - 410.01$; $R^2 = 0.9105$) reflects strong and consistent expansion, while Malaysia's trend ($y = 357.32x + 8{,}158.9$; $R^2 = 0.7177$) indicates more moderate growth. In 1994, Indonesia exported 2.65 million tons compared to Malaysia's 8.5 million tons (U.S. Department of Agriculture (USDA), 2023). By 2005, Indonesia's exports surged to 12.7 million tons, increasing 379% due to production growth, export liberalization, and foreign investment (R. Susila, 2010). Exports reached 38 million tons in 2024 (Purba & Dwi, 2021), supported by demand from India, China, and the EU, while Malaysia's exports grew more slowly to 19.3 million tons amid land constraints and stricter environmental policies (Rosegrant et al., 1998). Together, both countries control over 80% of global exports (Slette & Wiyono, 2022), with Indonesia maintaining leadership since 2007 through downstream policies and export incentives (Pahan, 2012), reflecting distinct growth strategies (Syahza, 2004).

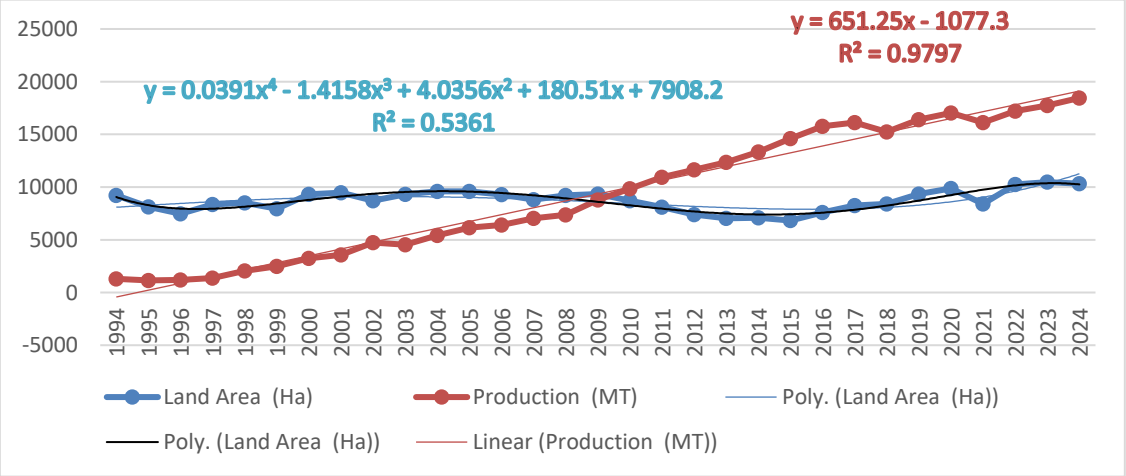
**Development of Vegetable Oil Soybean Oil Major Producing Countries**

***Area and Production of Soybean Oil Major Producing Countries***

Soybean is a major vegetable oil commodity with a strategic role in global trade. The leading soybean-producing countries are the United States, Brazil, Argentina, and China. The United States ranks first, with extensive planting areas across the Midwest particularly Iowa, Illinois, and Minnesota supported by advanced agricultural technology

and efficient land management systems. Most U.S. soybeans are processed into soybean oil and soybean meal for domestic use and export.

Brazil is the main competitor to the United States in global soybean production. Favorable agroclimatic conditions and government policies encouraging land expansion in regions such as Mato Grosso and Paraná have significantly increased its production and harvested area. Brazil is also a major exporter of soybean oil to Asian and European markets. Argentina ranks third, characterized by an integrated processing industry in which most soybeans are domestically processed into high-value products such as soybean oil and soybean meal for export.Although China has a relatively large soybean cultivation area, domestic production remains insufficient to meet rapidly growing demand. China is the world's largest soybean consumer and processor, relying heavily on imports from the United States and Brazil. Overall, the expansion of soybean area and output in major producing countries highlights its critical contribution to global vegetable oil supply. Moreover, competition between soybean oil and palm oil (CPO) in international markets continues to intensify, as both serve as substitutes in food, industrial, and renewable energy sectors.




Source: Index Mundi, 2025 (Processsed)

**Figure 4.** Development of Area and Production of China's SBO from 1994 to 2024

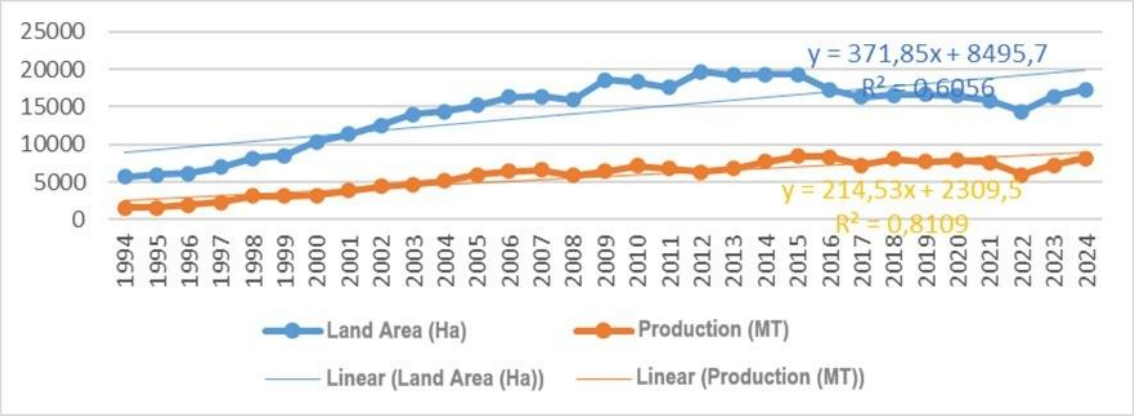
Figure 4 illustrates the development of soybean harvested area and soybean oil (SBO) production in China over the period 1994–2024. Overall, production shows a strong and nearly linear upward trend, with an estimated annual growth rate of about 651.25 and a very high coefficient of determination ($R^2 \approx 0.98$), indicating consistent and predictable expansion. In contrast, harvested area follows a more fluctuating and nonlinear pattern, with a moderate long-term increase and a lower $R^2$ of approximately 0.54. This statistical difference suggests that China's rising SBO output has been driven more by productivity gains, technological improvement, and efficiency enhancement than by land expansion, particularly after the mid-2000s.

In 1994, China's soybean area was about 8.2 million hectares, with soybean oil production reaching 2.1 million tons (USDA, 2024). By 2005, the area increased to 9.6 million hectares and production rose to 3.4 million tons, reflecting a 61% increase within a decade. The most significant growth occurred during 2005–2010, when output climbed from 3.4 to 4.9 million tons (44%), supported by rapid expansion of the crushing industry and rising domestic demand for vegetable oil and feed (Huang, 2022).

During 2012–2017, growth slowed as China became increasingly dependent on soybean imports from the United States and Brazil to supply its processing industry. To

address this vulnerability, the government launched the Soybean Revitalization Plan in 2018 to enhance domestic self-sufficiency. By 2024, harvested area reached approximately 11.5 million hectares and soybean oil production increased to 6.1 million tons—about 190% higher than in 1994—with an average annual growth rate of 3.8% (Azwar, 2015). The largest percentage increase occurred during 2018–2024, when production expanded by 28%, driven by improved seed varieties, mechanization, and policy support in key northeastern provinces such as Heilongjiang, Jilin, and Liaoning (Rosegrant et al., 1998).

Despite rising output, domestic consumption continues to grow rapidly due to urbanization, dietary shifts, and expansion of the processed food industry, maintaining China's reliance on soybean imports (OECD, 2023). Overall, the trend reflects the impact of agricultural revitalization and agro-industrial policies aimed at strengthening food and energy security, while highlighting the ongoing challenge of import dependency in ensuring stable soybean oil supply.




Source: Index Mundi, 2025 (Processed)

**Figure 5.** Development of Area and Production of SBO Argentina from 1994 to 2024

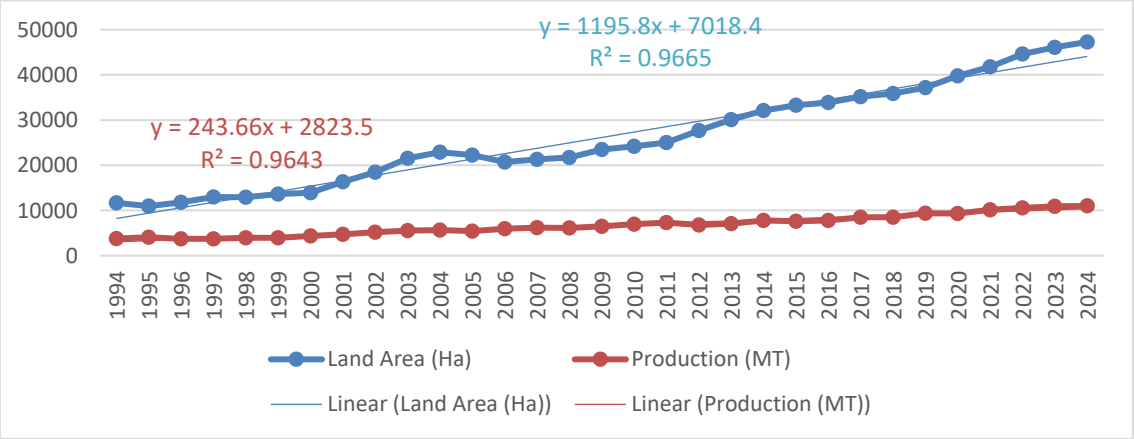
Figure 5 presents the development of soybean harvested area and soybean oil (SBO) production in Argentina during 1994–2024. Overall, both variables exhibit a significant upward trend, reinforcing Argentina's position as one of the world's leading soybean oil producers and exporters. Linear trend estimation shows that harvested area follows the equation $y = 371.85x + 8{,}495.7$ ($R^2 = 0.6056$), indicating a moderately strong upward trend with noticeable annual fluctuations. In contrast, soybean oil production follows $y = 214.53x + 2{,}309.5$ ($R^2 = 0.8106$), reflecting a stronger and more consistent relationship with time. The higher $R^2$ for production suggests that productivity improvements and industrial efficiency have played a more decisive role than land expansion.

In 1994, Argentina's soybean area covered approximately 6.4 million hectares, with soybean oil production reaching 2.7 million tons (Meydani et al., 1991). By 2005, harvested area expanded to 14.2 million hectares and production rose to 5.8 million tons an increase of about 115% compared to 1994. The most pronounced growth occurred during 2000–2005, when production increased by 41%, driven by rapid expansion of the soybean crushing industry along the Paraná River (Clemente & Cahoon, 2009).

After 2010, growth continued at a more moderate pace. Soybean oil production reached 7.4 million tons in 2015 and approximately 8.9 million tons in 2024, representing a 20% increase over nine years, with an average annual growth of 2.1%. The largest percentage change occurred during 1995–2005, exceeding 100%, reflecting Argentina's

agricultural boom fueled by high global soybean prices and the adoption of no-tillage farming technologies that enhanced productivity (IMARC, 2020).

Key drivers of Argentina's soybean oil expansion include the adoption of modern agricultural technologies such as transgenic varieties and efficient irrigation systems, large-scale domestic crushing capacity, and government policies promoting exports of value-added products rather than raw soybeans (Syahza, 2019). Argentina is currently the world's largest exporter of soybean oil, supplying more than 40% of global exports, mainly to India, Bangladesh, and the European Union. Overall, the figure reflects a vertically integrated growth model linking upstream cultivation with downstream processing. While Argentina has strengthened its global competitiveness in vegetable oil markets, challenges such as global price volatility, domestic inflation, and export dependence remain critical for the long-term sustainability of its soybean oil sector.




Source: Index Mundi, 2025 (Processed)

**Figure 6.** Development of Area and Production of Brazilian SBO from 1994 to 2024

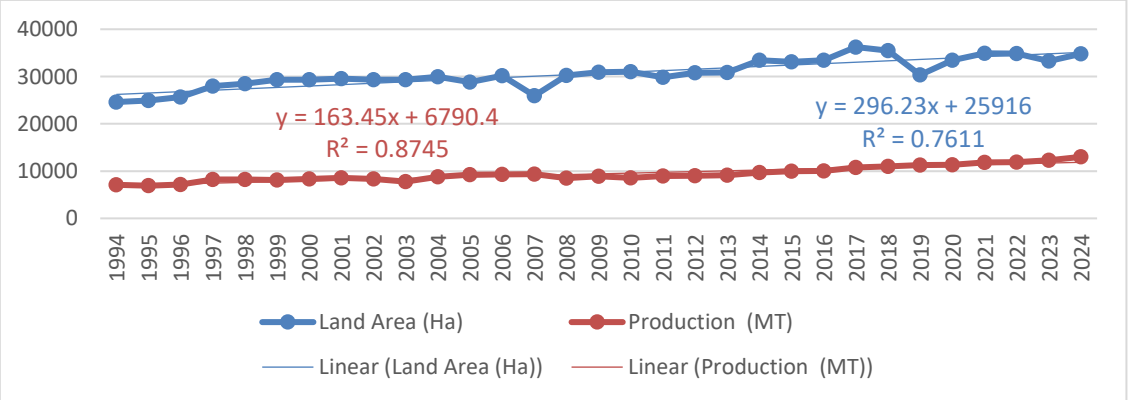
Figure 6 illustrates the development of soybean harvested area and soybean oil (SBO) production in Brazil over the period 1994–2024. Both variables display a very strong and consistent upward trend, positioning Brazil as one of the world's largest soybean oil producers and exporters. The linear trend for harvested area is $y = 1{,}195.8x + 7{,}018.4$ with $R^2 = 0.9665$, indicating that nearly all variation is explained by time. Similarly, SBO production follows $y = 243.66x + 2{,}823.5$ with $R^2 = 0.9643$, reflecting a very strong relationship between time and output growth. Despite minor mid-period fluctuations, the overall pattern shows sustained land expansion accompanied by continuous production growth, suggesting long-term capacity improvement in Brazil's soybean oil sector.

In 1994, Brazil's soybean area reached approximately 10.2 million hectares, with soybean oil production at 3.6 million tons (Vieira et al., 2021). By 2005, harvested area expanded to 22.4 million hectares and production rose to 6.8 million tons—an 89% increase compared to 1994. The most rapid growth occurred during 2000–2005, when production grew by 42%, driven by large-scale agricultural expansion in Mato Grosso, Goiás, and Paraná, supported by agribusiness-oriented policies, improved infrastructure, and private investment in processing industries (Braga, 2024).

During the following decade, Brazil further strengthened its global position. Soybean oil production reached 8.2 million tons in 2015 and increased to 10.4 million tons in 2024, representing a 26.8% rise over nine years, with an average annual growth of 2.7%. The most significant overall expansion occurred during 1995–2005, exceeding 85%, reflecting a national acceleration phase supported by mechanized farming systems, drought-resistant varieties, and conservation agriculture practices.

Beyond land expansion, the growth of Brazil's soybean processing industry has been crucial. Since 2004, the National Biodiesel Program (PNPB) has promoted soybean oil as a biodiesel feedstock, increasing domestic demand and expanding processing capacity. By 2024, about 70% of Brazil's soybean oil production was exported—mainly to India, China, and Pakistan—while the remainder supplied the domestic biodiesel industry (Gerde et al., 2020).

Overall, the figure demonstrates that Brazil's soybean oil growth results from the interaction of economic incentives, energy policies, and agricultural technological innovation. Brazil has developed a vertically integrated soybean oil system from upstream cultivation to downstream processing, becoming a major competitor to the United States in global vegetable oil markets. However, rapid land expansion has raised environmental concerns, particularly deforestation in the Amazon. Consequently, current policies increasingly emphasize sustainable productivity, soybean certification, and strengthening the domestic biodiesel industry as part of Brazil's green development and energy security strategy.




Source: Index Mundi, 2025 (processed)

**Figure 7.** Development of Area and Production of SBO in the United States, 1994-2024

Figure 7 presents the development of soybean harvested area and soybean oil (SBO) production in the United States during 1994–2024. The graph shows a stable and sustained upward trend, reflecting the high efficiency of the country's modern agricultural system. The linear trend indicates that harvested area follows $y = 296.23x + 25{,}916$ ($R^2 = 0.7611$), while SBO production follows $y = 163.45x + 6{,}790.4$ ($R^2 = 0.8745$). The higher $R^2$ for production suggests that output growth has been more consistent than land expansion, emphasizing the role of productivity improvements rather than extensive expansion.

In 1994, U.S. soybean area reached 26.8 million hectares, with soybean oil production at 6.1 million tons. By 2005, area expanded to 30.5 million hectares and production rose to 8.4 million tons—an increase of 38%. The most notable growth occurred during 2000–2005, driven by strong demand from the food industry and expanding exports to Asian markets. Production continued rising to 10.1 million tons in 2015 and 11.8 million tons in 2024, averaging 2.3% annual growth over the last nine years. Productivity gains were supported by precision agriculture, genetically modified varieties, and climate-based land management systems. Key drivers include long-term agricultural policy stability under the Farm Bill, the Renewable Fuel Standard (RFS) since 2007 to promote biodiesel, and strong demand from food and feed industries.

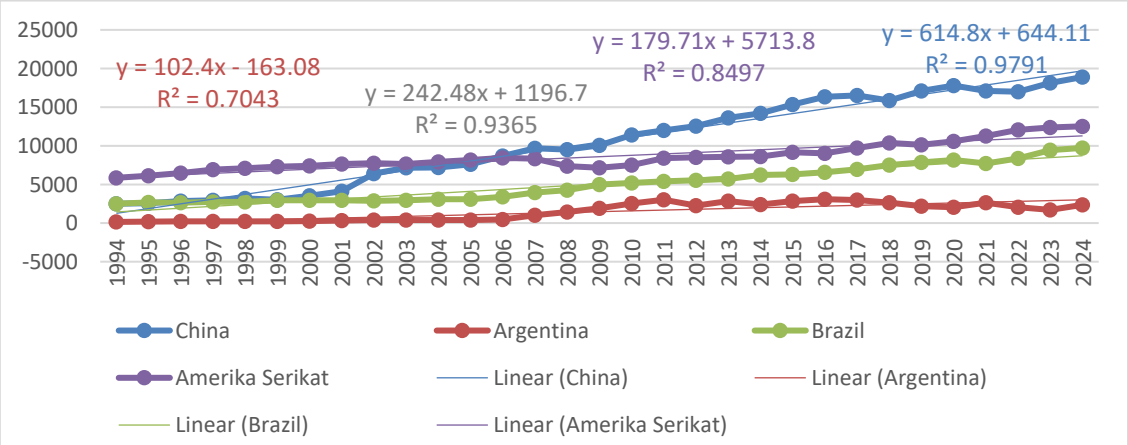
Approximately 80% of U.S. soybean oil production is absorbed domestically, with the remainder exported to markets such as Mexico, South Korea, and China.

Overall, U.S. soybean oil growth is predominantly intensive, relying on technological innovation and efficiency gains rather than large-scale land expansion as seen in Brazil and Argentina. This model positions the United States as one of the most efficient vegetable oil producers globally while strengthening its competitiveness in the global soybean oil trade.

***Demand for Soybean Oil in Major Producing Countries***

Demand for soybean oil in major producing countries continues to rise in line with population growth, increasing per capita income, and changing global consumption patterns. The United States, as one of the world's largest producers, is also a major consumer of soybean oil for food processing, animal feed, and renewable energy. Federal policies promoting biodiesel under the Renewable Fuel Standard have strengthened domestic utilization of soybean oil, reducing reliance on fossil fuels and shifting part of soybean allocation from export markets to domestic energy use.

Brazil and Argentina, while leading exporters, also record substantial domestic demand. In Brazil, expansion of the food industry and the National Biodiesel Program has increased internal consumption of soybean oil, supporting demand stability despite export price volatility. Argentina, with its highly integrated crushing industry, absorbs significant volumes of soybean oil for processing and bioenergy, reinforcing its value-added export model. China remains the largest global consumer of soybean oil. Although it produces soybeans domestically, output is insufficient to meet growing demand, particularly for food and feed industries. Consequently, China relies heavily on soybean imports from the United States and Brazil for domestic processing into soybean oil and meal (USDA, 2025). Overall, soybean oil demand patterns in major producing countries are shaped by industrial development, bioenergy policies, and household consumption, all of which directly influence global vegetable oil price dynamics.




Source: Index Mundi, 2025 (processed)

**Figure 8.** Trends in Soybean Oil Demand in Major Producing Countries, 1994–2024

Figure 8 presents the evolution of soybean oil (SBO) demand in China, Argentina, Brazil, and the United States from 1994–2024. Demand increased in all countries, with China showing the fastest and most consistent growth (slope ≈614.8; $R^2$ ≈0.9791), indicating a structural shift of global demand toward Asia. Brazil also recorded strong and predictable expansion (slope ≈242.5; $R^2$ ≈0.9365), while the United States experienced moderate growth (slope ≈179.7; $R^2$ ≈0.8497). Argentina displayed slower and more fluctuating growth (slope ≈102.4; $R^2$ ≈0.7043). In 1994, demand stood at 2.4

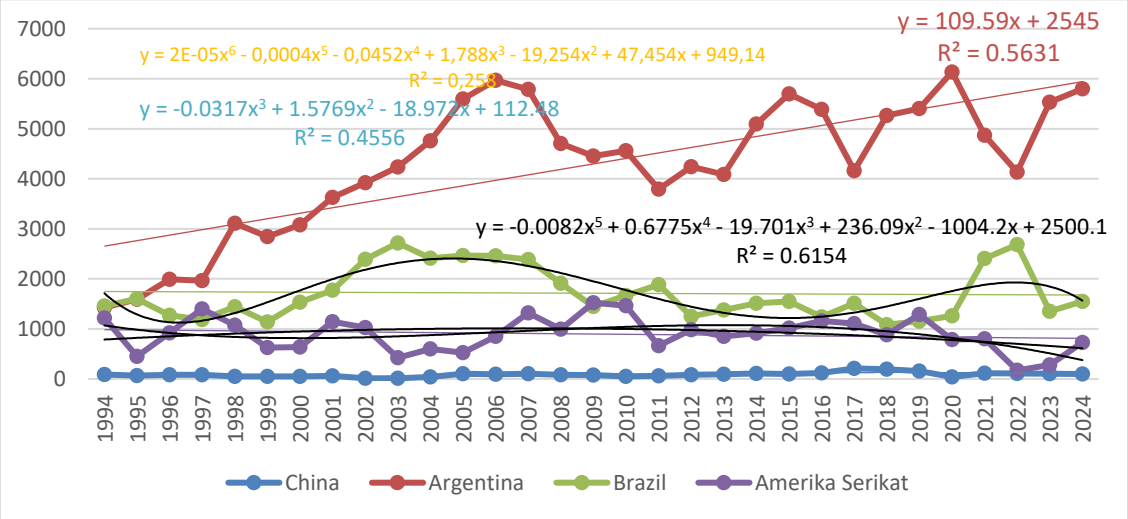
million tons in China, 1.6 million tons in Argentina, 2.8 million tons in Brazil, and 6.2 million tons in the United States .

China's demand surged to 10.6 million tons by 2024, increasing 342% since 1994, driven by economic expansion and processed food industry growth. Argentina's demand rose to 3.8 million tons, supported by biodiesel and food processing, while Brazil's consumption reached 6.3 million tons following the National Biodiesel Program (PNPB) (Meydani et al., 1991). U.S. demand grew steadily to 10.2 million tons, reinforced by the Renewable Fuel Standard. Overall, soybean oil demand reflects its dual strategic role in food security and renewable energy transition.

***Soybean Oil Exports by Major Producing Countries***

International soybean oil trade is primarily dominated by Argentina, Brazil, and the United States. Argentina is the world's largest exporter due to its highly efficient and integrated crushing industry, exporting value-added products such as soybean oil and soybean meal mainly to India, Bangladesh, and European markets. Brazil ranks second, supported by expanding soybean production, improved port infrastructure, and strong demand from India, China, and the European Union.

The United States also plays a significant role in exports, although a substantial share of its soybean oil is absorbed domestically for food and biodiesel under renewable energy policies. In contrast, China is not a major exporter because most of its production is used to meet large domestic consumption needs. Overall, global soybean oil exports are concentrated in South America, particularly Argentina and Brazil, which benefit from strong processing capacity and production efficiency.




Source: Index Mundi, 2025 (processed)

**Figure 9.** Soybean Oil Export Volume of Major Producing Countries, 1994-2024

Figure 9 illustrates the export volume of soybean oil (SBO) from major producing countries—Argentina, Brazil, the United States, and China—during 1994–2024. Overall, exports increased significantly in Argentina and Brazil, confirming their dominance in global soybean oil trade, while the United States showed moderate growth and China remained a marginal exporter due to high domestic absorption. Trend estimations indicate that Argentina recorded the strongest long-term growth ($y = 109.59x + 2{,}545$; $R^2 = 0.5631$), despite volatility, whereas Brazil displayed a nonlinear but upward pattern ($R^2 = 0.6154$). U.S. exports were relatively stable and smaller in scale, and China's exports remained below 0.2 million tons annually.

In 1994, Argentina exported about 2.3 million tons, rising to 6.8 million tons by 2024, accounting for 40–45% of global exports. Brazil increased from 1.4 to 5.7 million tons over the same period, supported by industrial expansion and the National Biodiesel Program (Mundi, 2025). U.S. exports grew modestly from 0.7 to 1.9 million tons while China remained primarily an importer and processor. Overall, global soybean oil exports are heavily concentrated in South America (IMARC, 2020)

## CONCLUSIONS AND SUGGESTIONS

This study concludes that the dynamics of palm oil and soybean oil in major producing countries over the period 1994–2024 reflect two distinct but interconnected development patterns in the global vegetable oil market. Palm oil production and trade are structurally dominated by Indonesia and Malaysia, with Indonesia exhibiting extensive growth driven by rapid land expansion, increasing domestic demand through biodiesel policies, and a strong export orientation. In contrast, Malaysia demonstrates a more intensive growth model characterized by productivity improvement and downstream diversification. These differences confirm that time trends strongly explain long-term expansion, yet national policy orientation and structural capacity determine the pace and sustainability of growth.

In the soybean oil market, production and trade are concentrated in the United States, Brazil, Argentina, and China, with South American countries emerging as dominant exporters due to integrated processing industries. China's rapid growth in demand highlights a structural shift in global consumption toward Asia, reinforcing the role of soybean oil in food security and energy transition. Overall, the findings contribute to industrial economics and agribusiness science by providing a comparative time-series framework that integrates production, demand, and export dynamics, thereby enhancing understanding of competitiveness, structural transformation, and sustainability challenges in global vegetable oil markets.

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