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Soy: The King of Beans

Khazanah Research Institute

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This view was prepared by Ahmad Ashraf Ahmad Shaharudin and Siti Aiysyah Tumin, researchers from the Khazanah Research Institute (KRI). It was reviewed by Dr Sarena Che Omar. Opinions expressed are those of the authors and may not necessarily represent the official views of KRI.

About Food Market series

Food Market is a series of articles published by Khazanah Research Institute (KRI) to analyse statistics related to some key food items in the diet of Malaysians. These articles intend to increase public knowledge and awareness on the production, trade and consumption of various food items in Malaysia.

These articles are short and informative, accessible to the public and policymakers. It utilises publicly available data (unless stated otherwise). They are not meant to study food-specific markets in-depth or make any policy recommendations.

The views expressed in this article are entirely those of the authors. They do not necessarily represent the views of KRI.

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Views

Soy: The King of Beans *article is part of the* Food Market *series of articles at KRI's website. It intends to provide a brief overview of the soy market in Malaysia, looking at its production, price, trade and consumption. Some insights are drawn for the benefit of the public and policymakers; however, this article is not meant to offer an in-depth analysis nor policy recommendations regarding the soy market.*

Executive Summary

- Soy is widely consumed in Asia, either as food or as feed for livestock. However, the region produces less than 10% of soybeans and in fact, Malaysia does not produce this legume. **Soybeans are mainly produced in the Americas (almost 90% of global production)**, whereby the United States, Brazil and Argentina alone produced 82% of the total global soybeans.
- Before 2005, **soybean oil had long been the leading vegetable oil**. However, **beginning 2006, palm oil has emerged as the top vegetable oil** produced. In 2013, 53.6 million metric tonnes (m MT) of palm oil was produced, as compared to 42.6m MT of soybean oil.
- The **United States and Brazil are the two largest exporters** of soybeans leaving Argentina far behind on the third place. **China, on the other hand, is the single largest importer** of soybeans—taking 63.7% share of the total global soybeans import in 2016. In this regard, China could be said as having a monopsony power in the international soybeans market.
- The most imported soy-based products to Malaysia is soybean cake[1], used for feed, followed by soybeans (whether or not broken). Malaysia disproportionately relies on **Argentina for soybean cake import (96% in 2017)** and on the **United States for soybeans (57% in 2017)**.
- Most of the soy in Malaysia is used for feed, in the form of soybean cake—1.7m MT in 2013[2]. **Soybean cake is the second largest source of feed in Malaysia** after maize and maize-products—29% of the total feed in 2013.

[1] Oil-cake and soybean cake are used interchangeably in this article. They refer to the same item. While FAOSTAT uses the term soybean cake, UN COMTRADE uses the term oil-cake.
[2] Due to data availability limitation, the ending year are different across different data, depending on the sources.

Introduction

Soy-based foods are ubiquitous in Asian meals. Whether it is our kitchen's must-have soy sauce, or the uniquely Southeast Asian *tempeh*, or *Pasar Malam*'s must-buy *tau fu fa*, they are all derived from soybeans. Soybean is not only rich with protein but also contains fat, carbohydrates, dietary fibres as well as minerals and phytoestrogens (or isoflavones)[3, 4]. It is unsurprising that when soybeans were first cultivated by the Chinese around 5,000 years ago, the legume was referred to as the "Yellow Jewel" and the "Great Treasure" due to its nutritious value. When it was then introduced to the Americas around 1765, the crop was dubbed the "King of Beans"[5].

Interestingly, despite consuming almost 40% of the soybeans, Asia produces less than 10% of the crop[6]. Malaysia, specifically, does not produce soybean and we import this legume.

Aside from being consumed as food, soybeans are also an important source of animal feed and vegetable oil. Thus, any issue in the soy market will not only affect soy-based industries but will likely affect livestock and vegetable oil industries too.

Did you know?

What is legume?

Soybean (*Glycine max*) is a family of legumes. In general, legume is "a plant that has its seeds in a pod, such as the bean or pea". Legume has a nitrogen fixation feature—the ability to acquire nitrogen from the atmosphere. The residual nitrogen helps to fertilise the soil, making it available to other plants. Hence why legumes are used in crop rotation.

The Food and Agricultural Organization (FAO) classifies legumes into **(i) pulses** (crops harvested solely for dry grain, such as kidney bean and chickpea), **(ii) vegetable crops** (crops harvested green for food, such as green peas), **(iii) oil-bearing crops** (crops used mainly for oil extraction, such as **soybeans**) and **(iv) fodder crops** (crops used exclusively for sowing purposes, such as alfalfa).

Sources: Cambridge Dictionary (n.d.), Soil Quality (n.d.) & FAO (n.d.-a)

[3] FAO (2004)
[4] Consumption of phytoestrogens-rich diets is associated with a lower risk of some diseases such as coronary heart diseases, osteoporosis, hormone-dependent forms of cancer and menopausal symptoms. Ibid.
[5] Safak (2017)
[6] Based on 2013 data from FAOSTAT. This is the latest available data (for consumption) from FAOSTAT.

Production and Price

Soybeans are mostly produced in the Americas[7], where production is almost 90% and consumption is around 53% of the respective world's total. In 2013, the Americas produced 102 million metric tonnes (m MT) of soybeans more than they consumed (a net producer) whereas Asia consumed 76m MT more than the continent produced (a net consumer) (Figure 1). Asia's largest consumer of soybeans, China (at 29% in 2013), only produced less than 4% out of the total global production.

Figure 1: Production, consumption and production surplus/deficit, soybeans, by region, 2013

Figure 1a. Production, consumption and production surplus/deficit, soybeans, by region, 2013 (m MT)

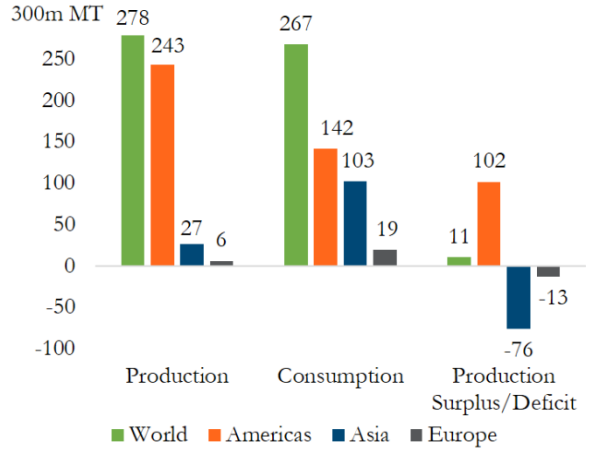
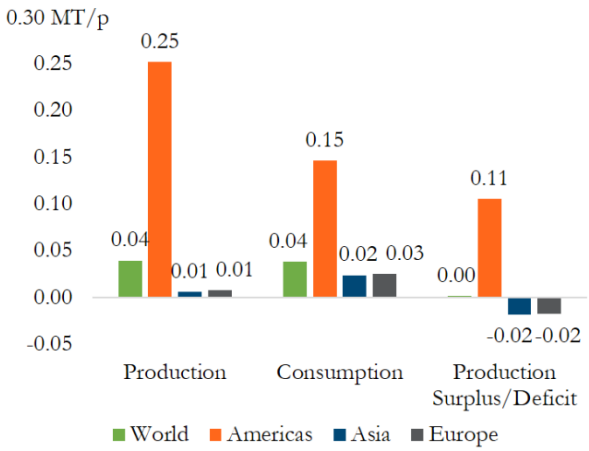


Figure 1b. Production, consumption and production surplus/deficit, adjusted for population, soybeans, by region, 2013 (MT/person)



Source: FAOSTAT. Charts by authors.

Notes:

1. Production surplus/deficit = Production – Consumption
2. Adjusted for population: Production or consumption divided by the population size
3. Data of the year 2013 is taken since the consumption data (domestic supply quantity) in FAOSTAT is only available up to 2013

This scenario, however, was different before the 1970s. In the 1960s, the United States and China were the two largest producers of soybeans (Figure 2a). This is before Brazil's and Argentina's production surpassed China's in 1974 and 1998, respectively. In 2017, the United States, Brazil and Argentina alone produced 82% of the total global soybeans (Figure 2b).

[7] Constitute North and South America continents

Figure 2: Production and production share of the top 5 producers, soybeans, 1961 – 2017

Figure 2a. Production, soybeans, 1961 – 2017 (m MT)

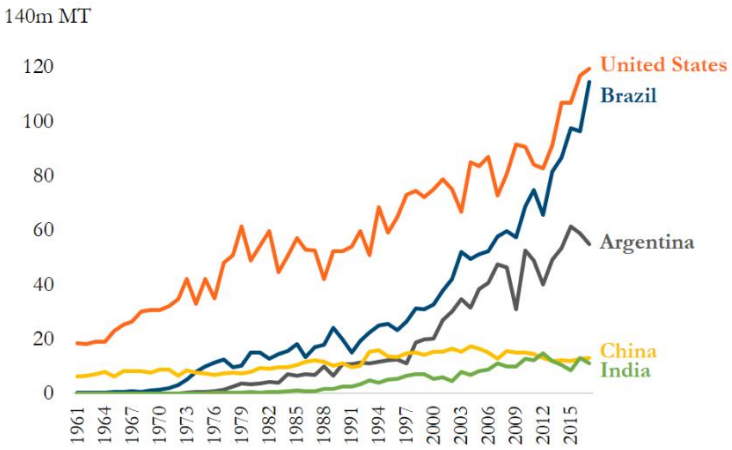
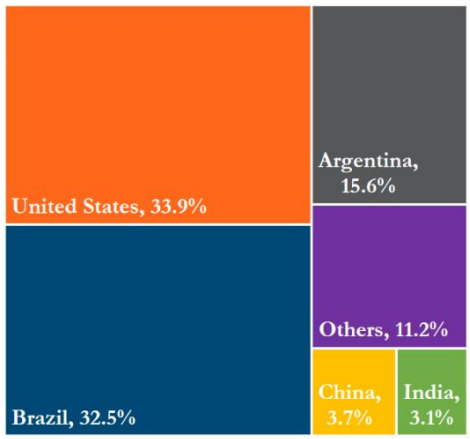


Figure 2b. Production share, soybeans, 2017 (%)



Source: FAOSTAT. Charts by authors.

Note: Production share: Percentage of production of the individual country over total global production

The combination of increasing harvested area and farm yield in Brazil and Argentina (Figure 3) has contributed to the exponential trend of soybeans productions in the two countries (Figure 2). Production between 1967 and 2017 increased by more than 55-fold in Brazil and 1,000 times in Argentina. The largest growth in hectarage in both countries happened in between 1967 to 1977—more than tenfold for Brazil and almost fourfold for Argentina. In terms of yield, between 1967 to 2017, Brazil's soybeans yield has increased by 189% whereas Argentina's by 167%. The largest growth in yield for both countries also happened within the period of 1967 – 1977.

On the other hand, between 1967 to 2017, China's harvested area for soybeans decreased by 14%, from 10.0m ha to 7.3m ha. The largest decreased was in between the years of 1967 to 1977. This period coincides with the Cultural Revolution, which caused a decline in China's agricultural production[8].

Figure 3: Harvested area and yield of the top five producers, soybeans, 1961 – 2017

Figure 3a. Harvested area, soybeans, 1961 – 2017 (m ha)

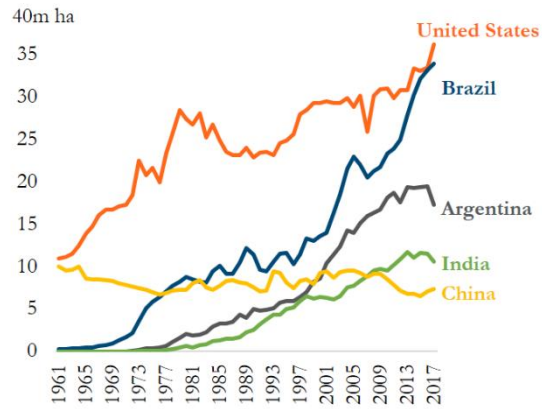
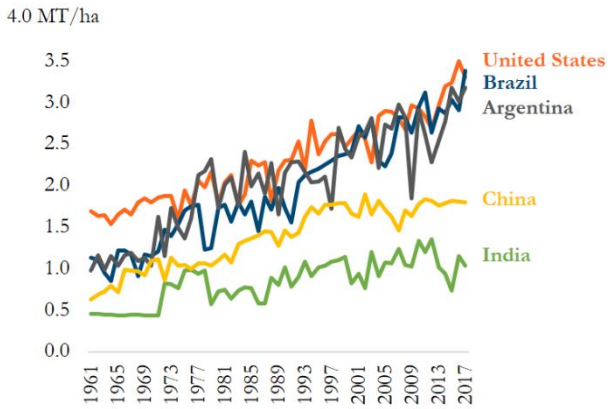


Figure 3b. Yield, soybeans, 1961 – 2017 (MT/ha)



Source: FAOSTAT. Charts by authors.

[8] Shurtleff and Aoyagi (2007)

Table 1: Growth of harvested area by decade, soybeans, 1961 – 2017

Country/Period	1967 – 1977	1977 – 1987	1987 – 1997	1997 – 2007	2007 – 2017
United States	45%	-1%	21%	-7%	40%
Brazil	1,055%	29%	26%	79%	65%
Argentina	3,717%	435%	81%	150%	8%
India	622%	691%	288%	48%	19%
China	-20%	23%	-1%	5%	-16%

Source: FAOSTAT. Calculation by authors.

Table 2: Growth of yield by decade, soybeans, 1961 – 2017

Country/Period	1967 – 1977	1977 – 1987	1987 – 1997	1997 – 2007	2007 – 2017
United States	25%	11%	15%	7%	18%
Brazil	51%	5%	24%	22%	20%
Argentina	79%	-11%	-9%	73%	7%
India	111%	-38%	85%	14%	-16%
China	9%	36%	22%	-18%	23%

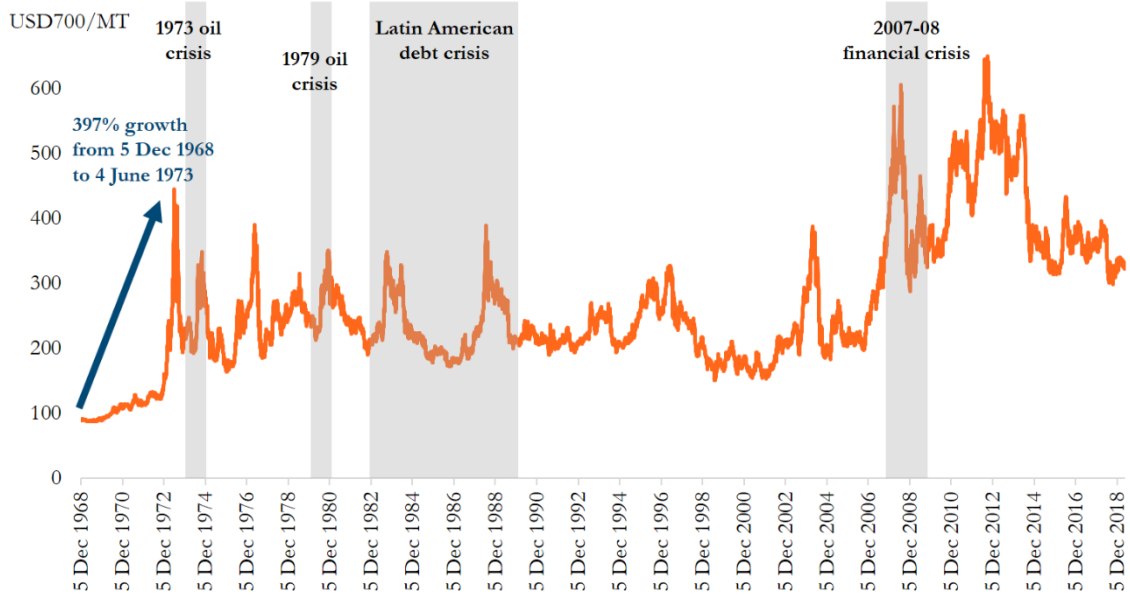
Source: FAOSTAT. Calculation by authors.

The soybean boom in Latin America in the 1960s and 70s can be associated with a few factors. One of them is the rapid increase in soybean price in the early 1970s—USD89.55/MT (RM274.13/MT) on 5 Dec 1968 to USD444.92/MT (RM1,087.09/MT) on 4 June 1973, astronomical rise of 397% within less than 4 years (Figure 4)[9]. The spike in price can be linked to the substantial crop shortfall[10] in the Soviet Union (USSR) in 1972, which led the country to net import 19.6m MT of grains[11] in 1972 – 1973, when in 1970 – 1971, USSR net exported 7.5m MT of grains. The anxious United States then imposed an embargo on soybeans export in summer 1973, worsening the crisis[12]. This, however, was seen as an opportunity for the Latin American countries to rise as an alternative soybeans' suppliers.

[9] Conversion to Ringgit Malaysia using data from World Bank (n.d.)
[10] Supply is less than demand
[11] Excluding rice
[12] Sanderson (1975)

Brazil is the second largest producer of soybeans, which production in 2017 was only 4% less than the United States. The expansion of soybeans hectarage in the country started in the 1960s, thanks to the government's programme intended to boost wheat production, which rendered positive spillover to soybeans. To optimise the use of land as well as agricultural machinery, the cultivation of wheat during winter was rotated with the cultivation of soybeans during summer[13]. In the first half of the 1970s, two branches of the federal government's National Company of Agricultural Research (EMBRAPA) were established that were pivotal in the development of the soy industry in Brazil—Embrapa-Cerrados (est. 1971), created for the development of agriculture in the Cerrado region and Embrapa-Soja (est. 1975), created specifically for soybean research and development (R&D)[14]. As a result of the state-sponsored expansion of soybean agribusiness, significant interventions in the soils pH and nutrient suitability were successfully made and translated into a jump in soybeans yield during 1967 – 1977 period.

Figure 4: Daily international price, soybeans, 1968 – 2018 (USD/MT)



Source: Macrotrends (Accessed 19 April 2019). Chart by authors.

Notes:

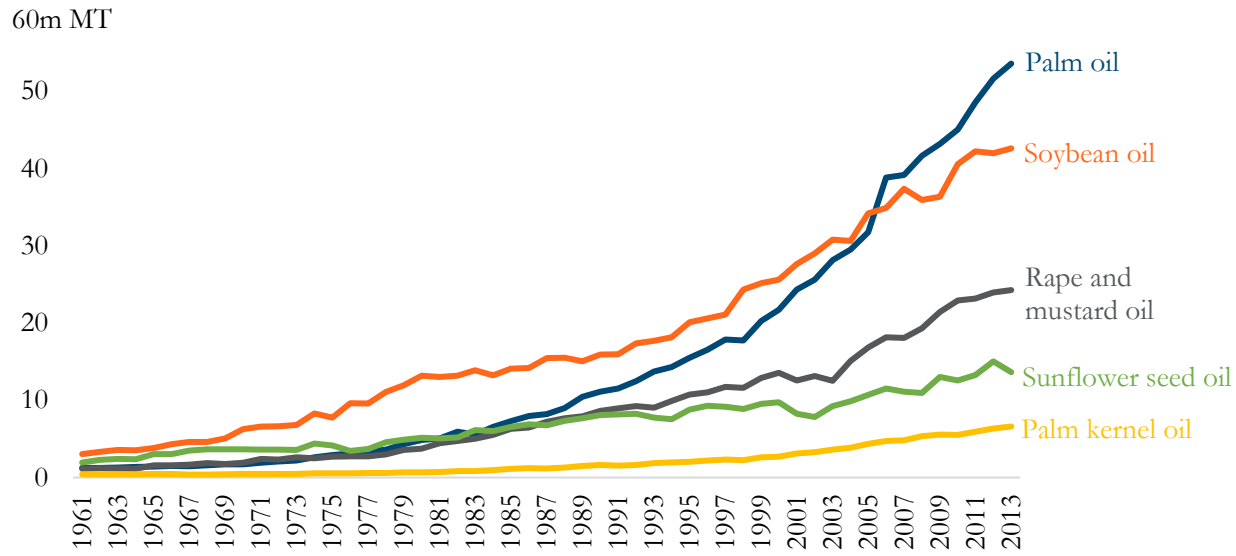
1. The data are given in USD/bushel in the original source and is converted by the author to USD/MT using the conversion of 1 MT = 36.74 bushels (for soybeans).
2. The source does not indicate clearly the reference of the prices. However, when compared with data from IMF that refers to "U.S. soybeans, Chicago Soybean futures contract (first contract forward) No. 2 yellow and par", the data are similar, with slight differences can be attributed to the unit conversion. IMF data are not used in this figure since the earliest data available is only from 1990.

[13] Cattelan and Dall'Agnol (2018)
[14] Oliveira (2016)

Box – Soybean oil and palm oil

Soybean is an important source of vegetable oil. Another main crop used to extract oil beside soybean is oil palm. Oil from oil palm is derived from two sources, the oil palm fruit and the palm kernels—both are categorised separately in FAO data[15]. By and large, most of the oil from oil palm is derived from the oil palm fruit, hence, whenever palm oil is mentioned, it refers to the oil derived from the oil palm fruit. Nevertheless, both palm oil and palm kernel oil are in the top five of vegetable oils produced (Figure 5).

Figure 5: Production of the top five vegetable oils, 1961 – 2013 (m MT)



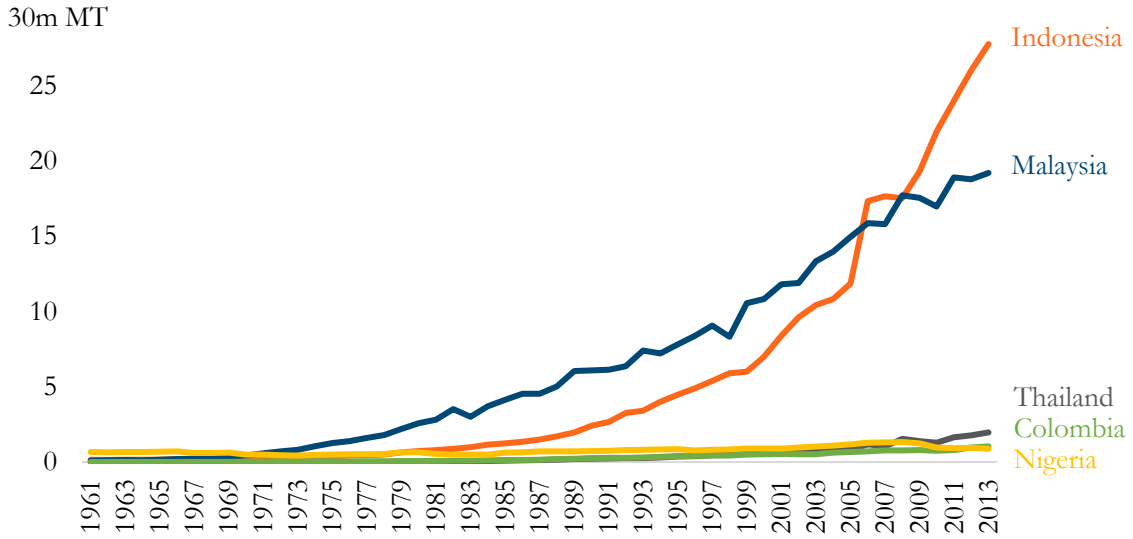
Source: FAOSTAT. Chart by authors.

Before 2005, soybean oil had long been the leading vegetable oil. However, beginning 2006, palm oil has emerged as the top vegetable oil produced (Figure 5). In 2013, 53.6m MT of palm oil was produced, as compared to 42.6m MT of soybean oil. Combining the palm oil and palm kernel oil, 60.2m MT of oil were derived from oil palm in 2013.

While the production of soybeans is dominated by the Americas, the production of oil palm is dominated by Southeast Asian countries, namely Indonesia and Malaysia. Prior to 2004, Malaysia was the top oil palm producing country before Indonesia took over. The other top five oil palm producing countries are Thailand, Colombia and Nigeria (Figure 6).

[15] FAO (n.d.-b)

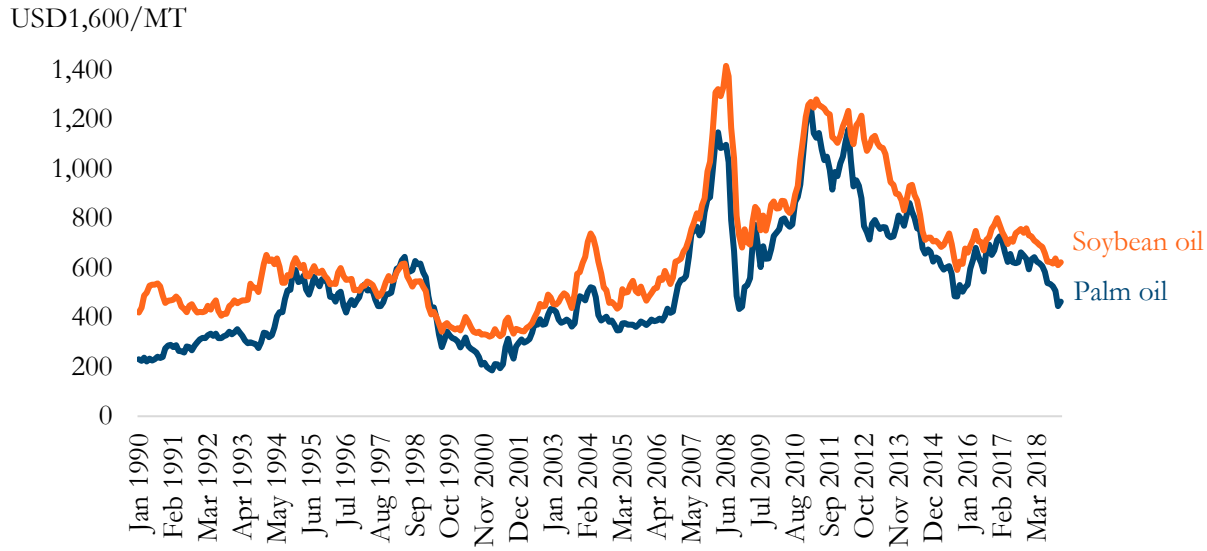
Figure 6: Production of oil palm by the top five producers, 1961 – 2013 (m MT)



Source: FAOSTAT. Chart by authors.
Note: Data in Figure 6 is the production of the oil palm crop, and not the production of the palm oil that is derived from the oil palm crop (as in Figure 5)

The prices of palm oil and soybean oil have always moved in tandem (Figure 7). Palm oil has always been cheaper than the soybean oil, except from February 1998 to April 1999, which could be explained by the Asian financial crisis.

Figure 7: Monthly prices of soybean oil and palm oil, 1990 – 2018 (USD/MT)



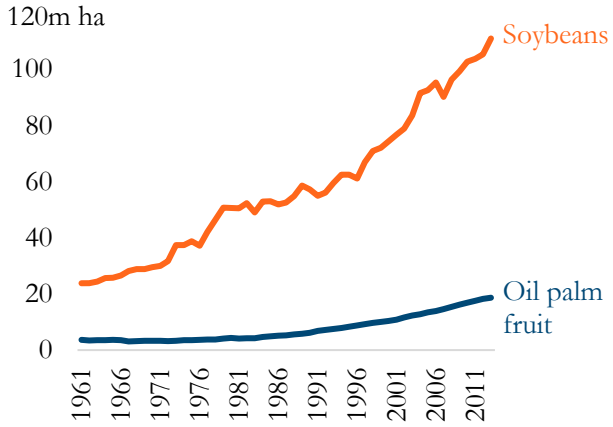
Source: IMF Primary Commodity Prices. Chart by authors.
Notes:
1. Soybean oil: Chicago Soybean Oil Futures (first contract forward) exchange approved grades
2. Palm oil: Malaysia Palm Oil Futures (first contract forward) 4-5 per cent FFA

The ascension of palm oil, dethroning soybean oil as the main vegetable oil in 2016, as well as the difference in the group of countries producing each crop, has led to frictions in the international politics of vegetable oils. One point of contention is the sustainability in the production of the crop. Although soybean production is also associated with deforestation—in fact, according to WWF, soybean production is the second largest agricultural driver of deforestation after beef production[16]—oil palm generally suffered worse publicity.

In terms of the use of land resources, despite palm oil being the dominant vegetable oil, soybeans harvested area was almost six times the harvested area of oil palm in 2013, 111.0m hectares (ha) compared to 18.7m ha of palm oil harvested area (Figure 8). From 1961 to 2013, soybeans harvested area increased by 87m ha, compared to oil palm, which increased by 15m ha.

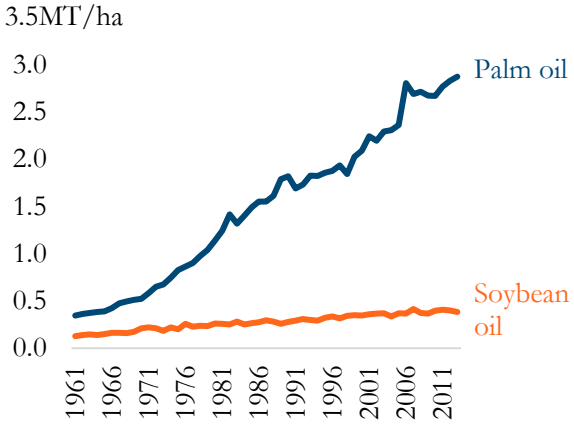
In 2013, the soybean oil's yield was 0.38 MT/ha (i.e. 2.6 ha of land were harvested to produce 1 MT of soybean oil), whereas the palm oil's yield was 2.87 MT/ha (i.e. 0.4 ha of land were harvested to produce 1 MT of palm oil) (Figure 9 & 10).

Figure 8: Harvested area, soybeans and oil palm fruit, 1961 – 2013 (m ha)



Source: FAOSTAT. Chart by authors.

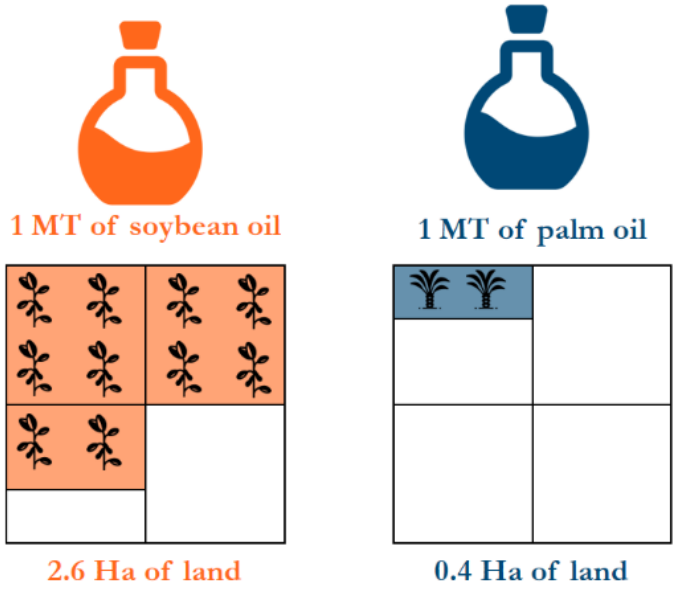
Figure 9: Yield, palm oil and soybean oil, 1961 – 2013 (MT/ha)



Source: Author's' calculation based on harvested area and production data from FAOSTAT

[16] World Wildlife Fund (WWF) (2016)

Figure 10: Harvested land per 1 MT of oil, 2013



Source: Data from FAOSTAT. Calculation and illustration by authors.

Beside land resources, the income level of the farmers producing the crops should also be considered when discussing sustainability. For instance, from a macro perspective, while the top producer of soybeans is the United States, a developed country, the top producer of palm oil is Indonesia, a developing country.

This is not to suggest that palm oil is more sustainable than soybean oil, neither that we have to choose between the two, but rather to highlight that there are many aspects that need to be looked at when assessing the sustainability of the crop production. An effective and fair environmental policy at the domestic and international level would look at these aspects objectively.

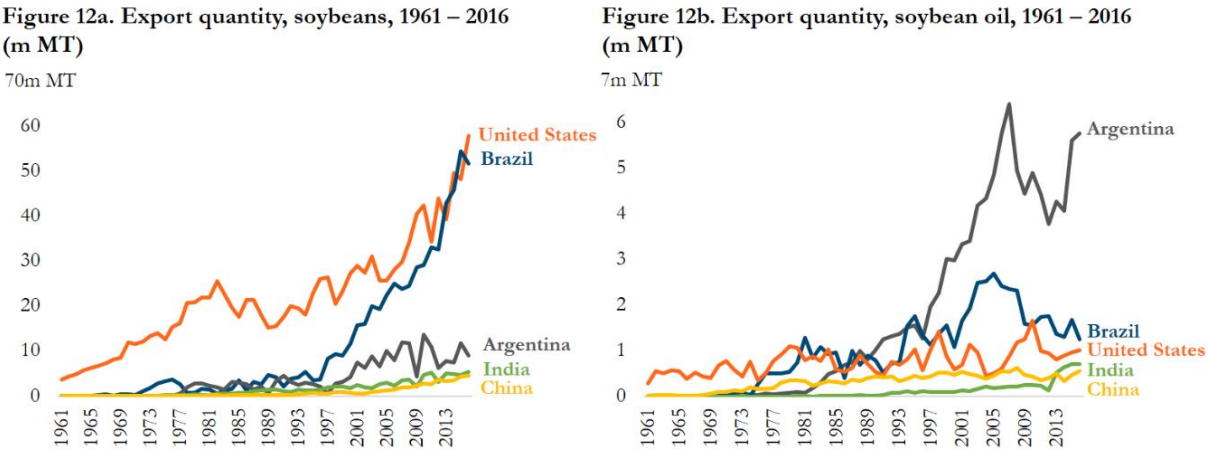
Trade

Soybeans were exported ten times more than the soybean oil, in quantity. In 2016, 134.9m MT of soybeans was exported, compared to 12.5m MT of soybean oil[17]. The top five exporters of soybeans are also the top five exporters of soybean oil. However, while the United States and Brazil are the two largest exporters of soybeans leaving Argentina far behind on the third place, Argentina is the single largest exporter of soybean oil, exporting five times more than Brazil, the runner up (Figure 12).

On the other hand, the top five importers of soybeans and soybean oil are of different groups of countries, except China who is one of the largest importers for both products (Figure 13). A stark observation from Figure 13a is China's rapid increase in soybeans import started in 1999. From 1999 to 2016, China's soybeans import surged by almost 13 times. China took 63.7% share of the total global soybeans import in 2016, while the Netherlands, the second largest importer took only 3.2%! In this regard, China could be said as having a monopsony power in the international soybeans market[18].

The import of soybean oil (Figure 13b), on the other hand, is dominated by India, whose import quantity began to accelerate in 2014, from 1.1m MT in 2013 to 2.1m MT in 2014 and more recently 3.9m MT in 2016. India took a 31.5% share of the total global soybean oil import in 2016, followed by Bangladesh with only 6.6% of the share. China's import of soybean oil has been fluctuating vigorously since 1993.

Figure 12: Export of the top five exporters, soybeans & soybean oil, 1961 – 2016 (m MT)



Source: FAOSTAT. Charts by authors.

[17] FAOSTAT

[18] Monopsony is defined as "A market situation in which there is only one buyer." Oxford Dictionaries (n.d.)

Figure 13: Import of the top five importers, soybeans & soybean oil, 1961 – 2016 (m MT)

Figure 13a. Import quantity, soybeans, 1961 – 2016 (m MT)

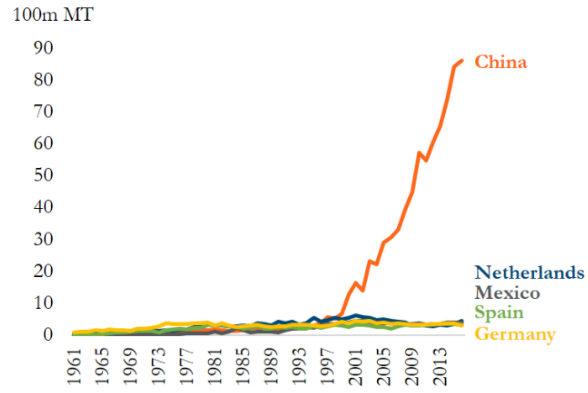
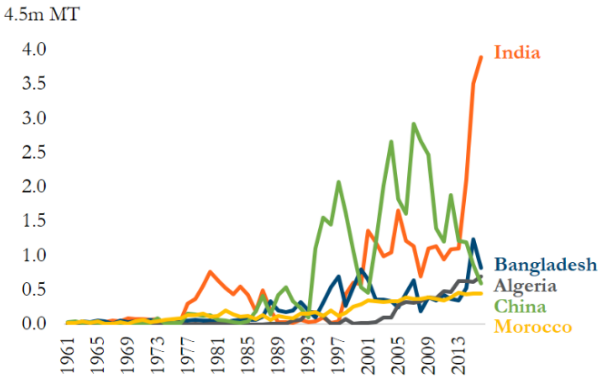


Figure 13b. Import quantity, soybean oil, 1961 – 2016 (m MT)



Source: FAOSTAT. Charts by authors.

Did you know?

China is one of the United States' largest export market for soybeans. However, the recent **trade war** between these countries affected American soybean farmers adversely. As the United States imposed tariffs on various goods, China **retaliated** by imposing tariffs on American exports to China, including soybeans.

The United States Department of Agriculture (USDA) expected that **25 million MT** of soybeans will go unsold in 2019 due to the trade war. Following the imposition of tariffs, stories on rotting unsold soybeans and bankrupted farmers emerged. To mitigate the negative effects of trade retaliation, the United States authorised a $12 billion **assistance program** for farmers as a short-term relief strategy.

Timeline: Soybeans in the Trade War

March 2018 – United States imposed 25% import tariffs on steel and 10% import tariffs on aluminium

April 2018 – United States released a list of 1,334 products subjected to 25% tariffs. China retaliated and proposed 25% tariffs on 106 products, including soybeans

July 2018 – China stopped purchasing soybeans from the United States

December 2018 – China resumed purchasing soybeans from the United States (1.5 – 2.0 million tonnes), amidst negotiations between both countries

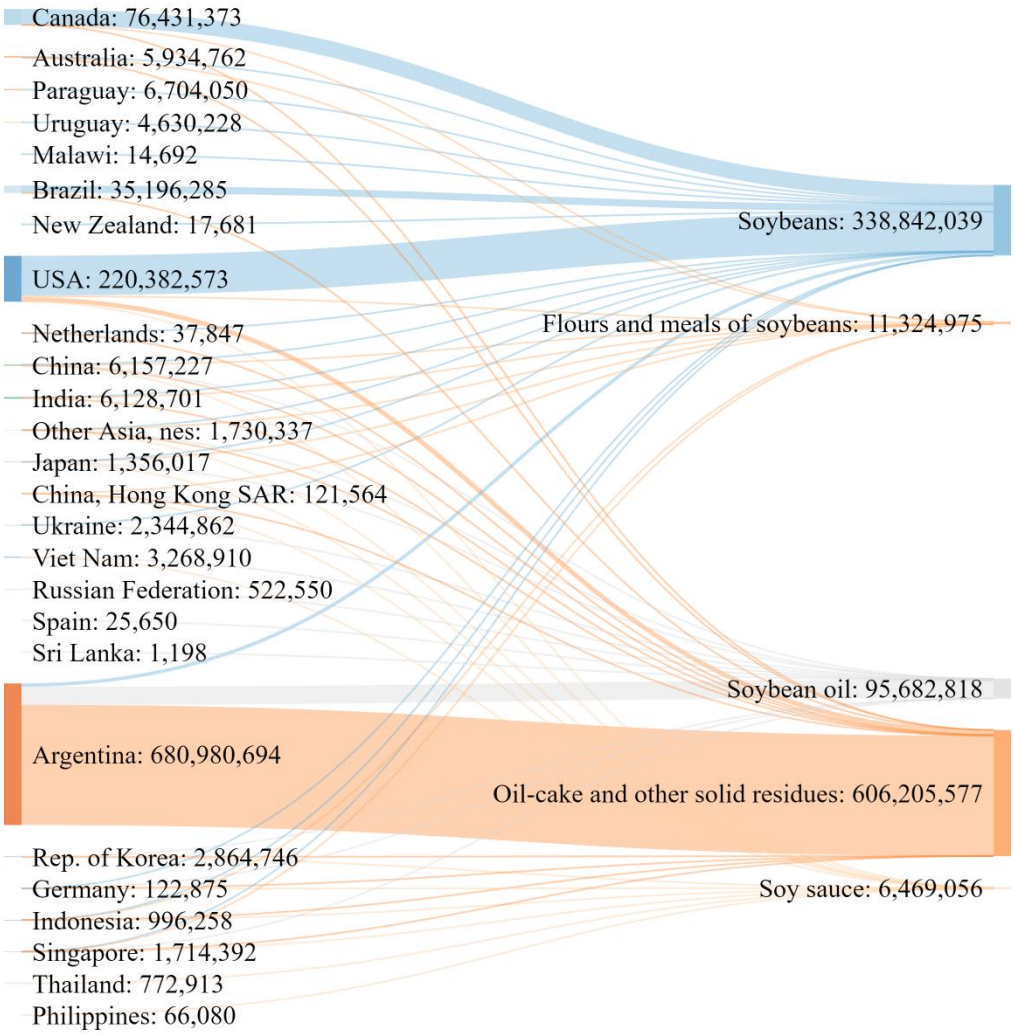
January 2019 – China offered to buy 5 million tonnes of soybeans from the United States

Sources: Adapted from Bloomberg News (2019), Wong (2019), Burroughs (2019), Lobosco (2018) and USDA (2018)

Since Malaysia does not produce soybeans, the country depends on import. Among soy-based products, the most imported item to Malaysia is oil-cake and other solid residues—1.61m MT (USD606m) in 2017 (Figure 14 & 15). Oil-cake is a residual product from the extraction of soy oil from soybeans, used for animal feed[19]. Malaysia relies heavily on Argentina to obtain oil-cake supply—96% in 2017(1.54m MT). The second most imported soy-based products are soybeans (whether or not broken)—0.80m MT (USD339m) in 2017 (Figure 14 & 15). Malaysia also disproportionately depends on a single source country for soybeans—57% of the imported soybeans are from the United States in 2017 (0.45m MT).

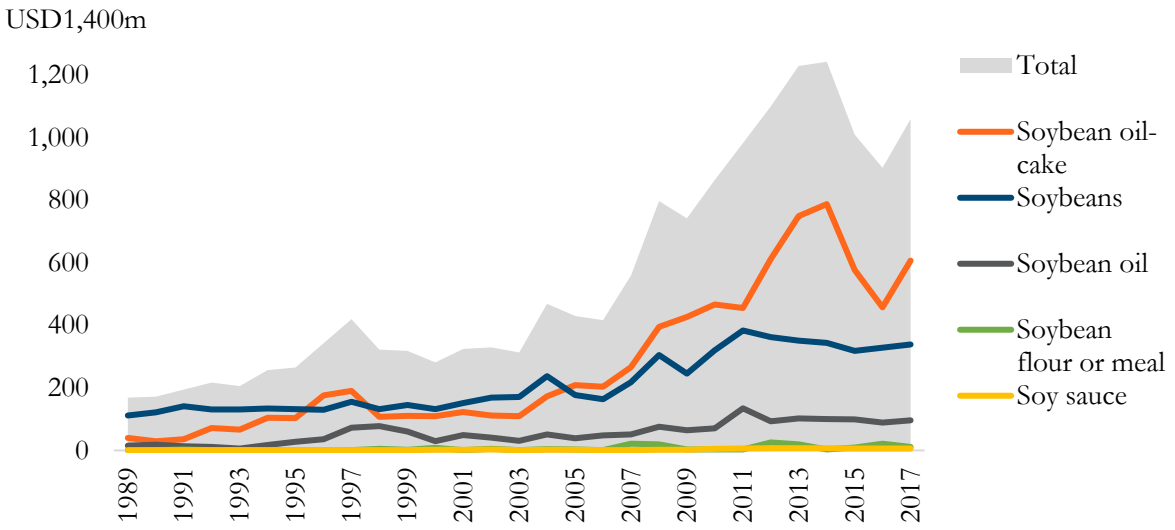
[19] Encyclopedia Britannica (n.d.). Also known as soybean cake.

Figure 14: Malaysia's import value and countries of origin, soy-based items, 2017 (USD)



Source: UN COMTRADE. Chart by authors.
Notes: On the left hand-side are the countries of origin for the imported products on the right hand-side. The value indicated next to the countries is the value sum of the various soy-based products sourced from those countries.

Figure 15: Malaysia's import value, soy-based items, 1989 – 2017 (m USD)



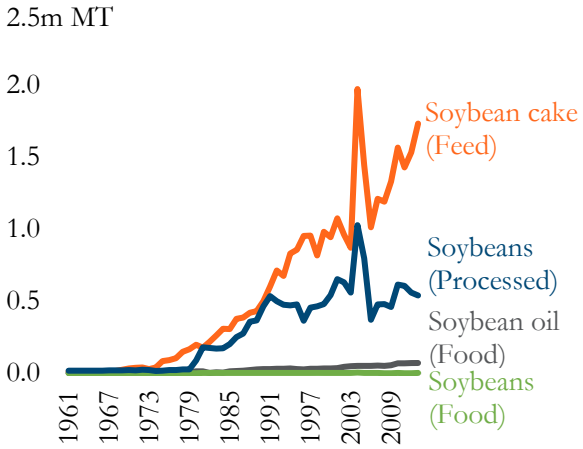
Source: UN COMTRADE. Chart by authors.

Consumption

Most of the soy in Malaysia is used as feed, in the form of soybean cake—1.7m MT in 2013 (Figure 16). Soybean cake is the second largest source of feed in Malaysia after maize and maize-products, 29% of the total feed in 2013 (Figure 17). Both maize and soybean cake is by and large imported. In the *Hala Tuju Kementerian Pertanian & Industri Asas Tani: Proriti & Strategi 2019-2020*[20], the Ministry of Agriculture and Agro-Based Industry (MOA) has stipulated the strategy of reducing the reliance on imported feeds through the development of corn grain industry and increasing the use of palm kernel cake (PKC) in the livestock industry.

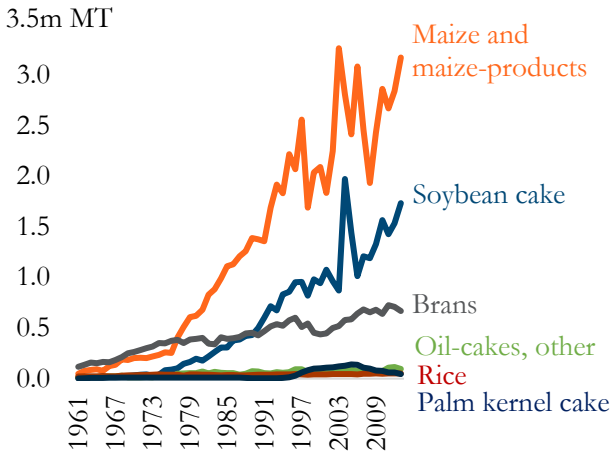
In 2013, a total of 71,000MT of soy was consumed as food in the form of soybeans and soybean oil (Figure 16). In addition, 339, 000MT of soybeans were processed into other products—however, based on the FAOSTAT data, disaggregation could not be made to determine the proportions of these soybeans that were turned into food items such as soy milk and industrial products such as soy ink.

Figure 16: Consumption of soy-based items, Malaysia, 1961 – 2013 (m MT)



Source: FAOSTAT. Chart by authors.
Note: Soybeans (Processed) refers to soybeans that are processed into other products.

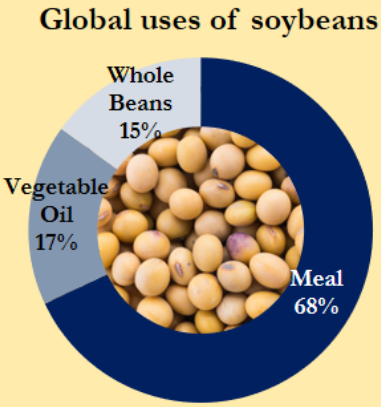
Figure 17: Sources of feed, Malaysia, 1961 – 2013 (m MT)



Source: FAOSTAT. Chart by authors.

[20] Ministry of Agriculture & Agro-Based Industry (MOA) (2019)

Did you know?



Globally, about 85% of the soybeans are crushed into meal and vegetable oil. The rest (15%) are sold as **whole beans**. For **meal**, 98% are used for **feed** while only 2% are for **food**. Within the **vegetable oil** category, 95% are used for **food** (cooking oil and food products such as margarines) and 5% for **industrial products** including biodiesel.

Sources: Seven (2018) and Ceres (2018). Chart recreated from Ceres (2018)

Conclusion

Soybean is an important crop for various reasons. Firstly, soybean is one of the main sources of animal feed. Globally, around 67% of the soybeans produced are converted to feed. Therefore, any issues in the soybean market will have significant impacts not only on the soy and soy-based industry but also the livestock industry. Secondly, soybean is also one of the main sources of vegetable oil. Before palm oil became the most produced vegetable oil in 2006, soybean oil was the dominant vegetable oil. Given that both oils are generally substitutable and the countries producing the two crops are of different groups, international politics might affect both industries. Thirdly, China holds a monopsony power in the soybean trade whereas the United States is the largest exporter of soybeans. The current US-China trade war would have remarkable consequences on the soy trade, potentially affecting countries that import this legume, including Malaysia.

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