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World Palm Oil Supply Forecast

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ABSTRACT

Due to the oversupply of palm oil in the year 2018-2019, the market price of crude palm oil (CPO) went to a historic low. The governments of world's two major palm oil producers, Malaysia and Indonesia, try to lift up the price at this moment by using policies such as biodiesel mandate and a moratorium on expanding the oil palm plantations. However, this article explains that a structural palm oil shortage may come in the near future. In order to analyse the reasons for this structural palm oil shortage and when it will occur, this article employed the age profiles of Malaysian and Indonesian oil palm plantation as well as the yield profile of oil palm. Using these age profiles and yield profile, this article can infer the palm oil production in the near future. According to the method used in this article, even without any weather effects, the supply of palm oil will decline in the future.

Keywords: palm oil, replanting, supply outlook, price outlook, Malaysia, Indonesia.

INTRODUCTION

The market price of crude palm oil (CPO) dropped to RM1966/t (BMD three months future) in 27 November 2018 and at the end of 2018, the annual average price of CPO turned out to be RM2299/t. Compared to 2016 (RM2630/t) and 2017 (RM2705/t), the CPO price in 2018 was a historic low. In 2019, the average CPO price turned out to be RM2250/t, which means the market was more bearish than 2018.

Just as the fundamental of a firm's stock price is its performance (EBITDA, Earnings, *etc.*), the fundamental of a commodity's price is its supply and demand. According to the Malaysian Palm Oil Board data (MPOB, 2020), the production of Malaysian palm oil (excluding kernel products) increased by 13% from 2016 to 2018. The production of Indonesian palm oil (including kernel products) increased by 37% during the same period as shown by the Indonesian Palm Oil Association data (GAPKI, 2020). This means that there was a rapid production growth that resulted in the decrease of palm oil price.

However, this rapid growth in production is getting slower and may even decline in the near future as oil palm plantations' replanting period is expected to occur, especially in Indonesia.

According to the US Department of Agriculture data (USDA, 2020), in average, the oil palm harvested areas in Indonesia increased by 31 000 ha per year before 1990s, by 218 000 ha per year during 1990s, and by 463 000 ha after the year 2001. In the case of Malaysia, the harvested area increased steadily compared with that of Indonesia. The oil palm harvested areas in Malaysia increased by about 90 000 to 130 000 ha per year from 1990s to 2000s.

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This rapid growth in harvested area has led to a huge increase in palm oil production, especially in Indonesia. Furthermore, the perennial crop, oil palm, yields different outcome at different age (Kushairi *et al.*, 2011). It means that the oil palm planted from late 1990s to early 2000s in Indonesia (which can be called as a 'baby-boomer generation') yielded a huge outcome of palm oil as they reached prime period or 10-20 year-old in the year 2017-2018. However, this 'baby-boomer generation' of oil palm area will face a replanting period after a prime period in the near future.

In addition to supply and demand, there are many factors that will affect the palm oil market and prices, such as US-China Trade War, other vegetable oil prices, and exchange rates. However, they are not expectable. Therefore, this paper focuses on the supply and demand of palm oil itself, which is easier to expect, has the most powerful and direct impact on palm oil price.

METHODOLOGY

Regarding harvested area and yield data, this article only uses data from the US Department of Agriculture (USDA) database. Although there are many other institutions (such as MPOB and GAPKI) that provide reliable palm oil data, this article uses only USDA data to eliminate biasness due to the use of different sources of database. Furthermore, the correlation between MPOB and USDA palm oil production data is 100%, so there is no problem of using USDA data.

In the USDA reports [Wahab (2019) and McDonald and Rahmanulloh (2019)], we can get the crucial data for supply forecast, which are 'harvested area of oil palm' and 'production of palm oil (excluding Kernel products)'.

Assuming that the planted area of oil palm is 1000 ha in the year 2000 and 1200 ha in the year 2001, we can easily infer that 200 ha of oil palm are planted in the year 2001. In 2020, we can also infer that there are 200 ha of 19-year-old oil palm (which were planted in the year 2001).

Based on the methodology above, we can have the age profiles of oil palm in Malaysia and Indonesia. The age profiles inferred with the methodology above are as in *Table 1*.

We can infer the palm oil production by multiplying the age profile (*Table 1*) with the yield profile in *Table 2*. According to the yield profile, for example, when oil palm is 3 years old, its fresh fruit bunch (FFB) productivity in medium condition is 8.0 t ha^{-1}. Based on the inferred age profile in *Table 1*, in the year 2018, there were 180 000 ha of 3-year-old oil palm planted in Malaysia.

In conclusion, when multiplying the two, we can infer that 3-year-old oil palm trees planted in Malaysia produced 1 440 000 t (180 000 ha x 8.0 t/ha) of FFB in 2018, assuming it was in medium condition.

Using the above methodology, we can infer the past palm oil production of Malaysia and Indonesia, with the assumptions below for simplification.

The first assumption is that oil palm is replanted at the age of 30 and the productivity of 25-year-old is maintained until 29-year-old. To achieve the desired productivity, it is recommended to replant the oil palm after it reaches 25-year-old. However, due to the high cost of replanting (the cost of replanting itself + 3 years of immature period), this rule is easily ignored in the real world.

This article simply assumes that the oil extraction ratio (OER) of oil palm in Malaysia is 23% and 20% in Indonesia. Though it is reported in MPOB that Malaysia's OER was around 20% in 2019, with the OER assumption above, this methodology can better explain the past world production data. Furthermore, OER is not a critical factor in forecasting the direction of palm oil production (whether it will increase or decrease).

This article assumes that Malaysian FFB productivity is 85% of the medium yield profile in *Table 2*, while Indonesia is 70%. When comparing the real past palm oil production and the inferred past production from this methodology, the yield profile used in this paper explains very well (correlation between inferred and real data: 99.5%).

This article assumes that in the near future (~2025), the production of palm oil from countries other than Malaysia and Indonesia will account for 15.5% of world production. The ratio, 15.5% of world production, came from the historical data (2015-2019). As the countries other than Malaysia and Indonesia have immature palm oil industry, their productivity is not as good as that of Malaysia and Indonesia. Therefore, though the other countries' palm oil industry is growing, it wouldn't make a significant change in world palm oil supply in the near future (~2025). Even if these countries expand their oil palm plantation from now on, the palm oil production won't grow significantly in the near future. Because they need to wait until the new oil palm plantations reach prime period, which typically comes 10 years after planting. When inferring past production, this article uses the actual data of the other countries' production.

Lastly, when inferring future production, weather factors such as *El Nino*, are excluded. Following the above methodology and assumption, the inferred palm oil

TABLE 1. AGE PROFILES OF OIL PALM IN MALAYSIA AND INDONESIA IN THE YEAR 2016-2018 ('000 ha)

Age/year	Malaysia			Indonesia		
	2016	2017	2018	2016	2017	2018
0	114	64	131	496	46	124
1	180	114	64	403	496	46
2	374	180	114	499	403	496
3	241	374	180	485	499	403
4	269	241	374	730	485	499
5	175	269	241	678	730	485
6	333	175	269	576	678	730
7	200	333	175	391	576	678
8	141	200	333	861	391	576
9	248	141	200	799	861	391
10	201	248	141	450	799	861
11	223	201	248	487	450	799
12	168	223	201	376	487	450
13	139	168	223	354	376	487
14	262	139	168	523	354	376
15	215	262	139	487	523	354
16	183	215	262	517	487	523
17	569	183	215	122	517	487
18	63	569	183	371	122	517
19	85	63	569	448	371	122
20	219	85	63	121	448	371
21	125	219	85	339	121	448
22	160	125	219	285	339	121
23	110	160	125	445	285	339
24	99	110	160	238	445	285
25	123	99	110	145	238	445
26	131	123	99	124	145	238
27	64	131	123	46	124	145
28	80	64	131	103	46	124
29	74	80	64	99	103	46
Planted area	5 568	5 558	5 609	11 998	11 945	11 966
Harvested area	4 900	5 200	5 300	10 600	11 000	11 300

Note: USDA provides seasonal data (October-September). This paper adopts the beginning year when using harvested area data, and adopts the ending year when using production data. The planted area of 0-2 year-old (immature) oil palm is excluded from the harvested area, because immature oil palm can't yield palm oil.

Source: Wahab (2019); McDonald and Rahmanulloh (2019).

production (spotted line) and the actual palm oil production (solid line) from 2001 to 2018 are as in *Figure 1* (George, 2020).

Excluding the 2016 data (when there was *El Nino*), the correlation between actual data and inferred data is 99.8%, which means that this methodology can also be a useful tool for forecasting the future production.

TABLE 2. YIELD PROFILE OF OIL PALM

Age of palm	FFB yield (t/ha/yr)		
	Low	Medium	High
0	-	-	-
1	-	-	-
2	-	-	-
3	4.6	8.0	10.5
4	8.8	12.0	15.5
5	13.1	18.0	22.0
6	17.1	22.0	26.0
7	20.4	26.0	31.0
8	21.4	27.0	32.5
9	22.4	28.0	33.5
10	22.4	28.0	32.5
11	21.4	27.0	31.0
12	19.5	25.0	31.0
13	19.5	25.0	31.0
14	19.5	25.0	31.0
15	19.5	25.0	31.0
16	18.5	23.0	28.0
17	18.5	23.0	28.0
18	18.5	23.0	28.0
19	18.5	23.0	28.0
20	18.5	23.0	28.0
21	16.0	21.0	25.5
22	16.0	21.0	25.5
23	16.0	21.0	25.5
24	16.0	21.0	25.5
25	16.0	21.0	25.5

Source: Kushairi *et al.* (2011).

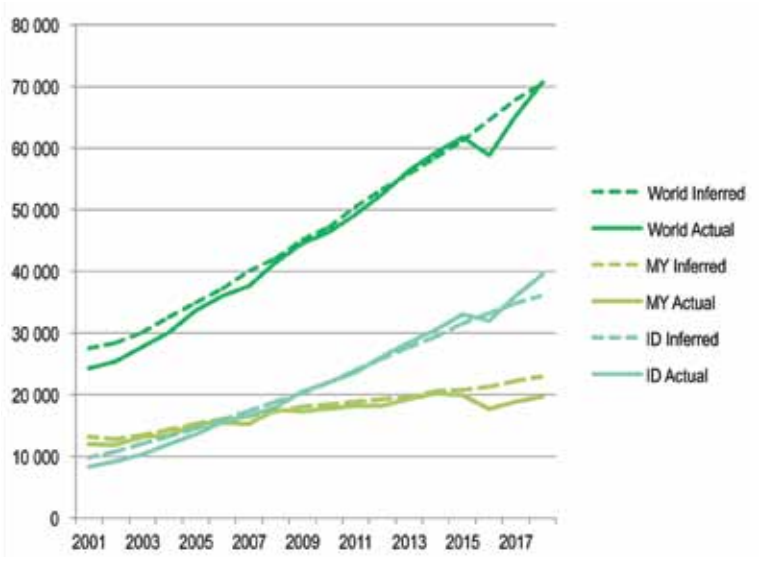

Figure 1. World, Malaysia (MY), Indonesia (ID) inferred and actual palm oil production ('000 t).

RESULTS AND DISCUSSION

The above methodology inferred the past production, and this same methodology can also be used to infer the production in the near future. This is possible with the assumption that the planted area will not expand in the near future. This is a reasonable assumption, as the governments of Malaysia and Indonesia are actually restricting the expansion of oil palm plantations. Assuming that the planted area will not expand, the only thing that can be changed in the near future is the age profile of oil palm plantation in the same area.

Inferring the future age profile of oil palm plantation (*Tables 3* and *4*), we can infer the future production of palm oil, as displayed in the graph (*Figure 2*).

According to *Figure 2*, palm oil production will peak in 2021 and then decline. It happens because of an expected, massive replanting in Indonesia. As stated in the introduction, Indonesia expanded its oil palm harvested area very rapidly from late 1990s to early 2000s.

This rapid expansion from late 1990s to early 2000s can explain why oversupply happened in between 2018 and 2019. At the same time, the replanting period of the oil palm planted in this period is expected and it will be a key factor in future supply reduction.

CONCLUSION

According to the United Nations report (2019), the world population will continue to grow to 8.5 billion by 2030 and per capita consumption of vegetable oil will also increase (Silva and Gurria, 2019). These two factors suggest that the consumption of vegetable oil, including palm oil, will grow. However, as shown in *Figure 2*, the palm oil supply may decline. This

TABLE 3. AGE PROFILE OF OIL PALM IN MALAYSIA IN THE YEAR 2019-2025 ('000 ha)

Age/ year	Malaysia						
	2019	2020E	2021E	2022E	2023E	2024E	2025E
0	123	131	123	99	110	160	125
1	131	123	131	123	99	110	160
2	64	131	123	131	123	99	110
3	114	64	131	123	131	123	99
4	180	114	64	131	123	131	123
5	374	180	114	64	131	123	131
6	241	374	180	114	64	131	123
7	269	241	374	180	114	64	131
8	175	269	241	374	180	114	64
9	333	175	269	241	374	180	114
10	200	333	175	269	241	374	180
11	141	200	333	175	269	241	374
12	248	141	200	333	175	269	241
13	201	248	141	200	333	175	269
14	223	201	248	141	200	333	175
15	168	223	201	248	141	200	333
16	139	168	223	201	248	141	200
17	262	139	168	223	201	248	141
18	215	262	139	168	223	201	248
19	183	215	262	139	168	223	201
20	569	183	215	262	139	168	223
21	63	569	183	215	262	139	168
22	85	63	569	183	215	262	139
23	219	85	63	569	183	215	262
24	125	219	85	63	569	183	215
25	160	125	219	85	63	569	183
26	110	160	125	219	85	63	569
27	99	110	160	125	219	85	63
28	123	99	110	160	125	219	85
29	131	123	99	110	160	125	219
Planted area	5 668	5 668	5 668	5 668	5 668	5 668	5 668
Harvested area	5 350	5 283	5 291	5 315	5 336	5 299	5 273

could lead to a shortage of palm oil, which might lift up the palm oil prices. This impact can be dramatic because the supply of palm oil is inelastic. There are also many other factors that can affect the palm oil prices. Especially in the long run, we can think about factors such as OER improvement via technology development as well as production growth from countries other than Malaysia and Indonesia. However, these factors will not threaten palm oil prices in the near future, as in the case of oil palm, it takes a long time to yield.

Furthermore, other vegetable oils, such as soyabean oil, rapeseed oil and sunflower oil, are not expected to offset the upcoming shortage of palm oil. Since the productivity of other vegetable oils is much lower than that of palm oil, they can't significantly increase production in a limited area. The methodology of this article assumed that Indonesian oil palm plantations will be replanted 124 000-238 000 ha annually from 2019 to 2021, but more

TABLE 4. AGE PROFILE OF OIL PALM IN INDONESIA IN THE YEAR 2019-2025 ('000 ha)

Age/ year	Indonesia						
	2019	2020E	2021E	2022E	2023E	2024E	2025E
0	145	124	145	238	445	285	339
1	124	145	124	145	238	445	285
2	46	124	145	124	145	238	445
3	496	46	124	145	124	145	238
4	403	496	46	124	145	124	145
5	499	403	496	46	124	145	124
6	485	499	403	496	46	124	145
7	730	485	499	403	496	46	124
8	678	730	485	499	403	496	46
9	576	678	730	485	499	403	496
10	391	576	678	730	485	499	403
11	861	391	576	678	730	485	499
12	799	861	391	576	678	730	485
13	450	799	861	391	576	678	730
14	487	450	799	861	391	576	678
15	376	487	450	799	861	391	576
16	354	376	487	450	799	861	391
17	523	354	376	487	450	799	861
18	487	523	354	376	487	450	799
19	517	487	523	354	376	487	450
20	122	517	487	523	354	376	487
21	371	122	517	487	523	354	376
22	448	371	122	517	487	523	354
23	121	448	371	122	517	487	523
24	339	121	448	371	122	517	487
25	285	339	121	448	371	122	517
26	445	285	339	121	448	371	122
27	238	445	285	339	121	448	371
28	145	238	445	285	339	121	448
29	124	145	238	445	285	339	121
Planted area	12 065	12 065	12 065	12 065	12 065	12 065	12 065
Harvested area	11 750	11 672	11 651	11 558	11 237	11 097	10 996

area can be replanted in the same period, fuelled by Indonesian government's replanting program. If the replanting period comes earlier than expected, the peak year (2021 in this article) may also be advanced.

In conclusion, based on the foreseen supply data, we can expect that the bearish palm oil market due to oversupply at this moment will turn into a bullish market within two to three years. Coupled with other factors, such as biodiesel consumption or weather issue, this bullish market can come faster.

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Figure 2. World, Malaysia (MY), Indonesia (ID) palm oil production outlook ('000 t).

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