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# WORLD PALM OIL SUPPLY FORECAST: REVIEW AND UPDATE

**MINCHUL SUH[1]***

**ABSTRACT**

*Since the beginning of oil palm business in the 1960's, world palm oil production has always shown an upward trend until the year 2019. Even though there were some occasions that made palm oil production go down, such as El Nino in the year 2015-2016, it was a temporary weather anomaly. However, this article explains that a structural, not a temporary, palm oil shortage may occur in 2-3 years. This article reviews the production data in the year 2019-2022 that was published by Minchul Suh (2020), mentioned as P.F hereinafter when the growth of the world's palm oil production was stagnant. This article forecasts palm oil production in the year 2023-2025, by employing the age profiles of Malaysian and Indonesian oil palm plantations as well as the yield profile of oil palm. According to the methodology used in this article, even without any weather effects, the growth of palm oil production will be stagnant or can even decline until the year 2025.*

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

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## INTRODUCTION

According to the data from the U.S. Department of Agriculture (USDA, 2023), world palm oil production has always shown an upward trend since its beginning in the 1960's until the year 2019. From less than 2 million tonnes in the 1960's, world palm oil production has grown rapidly to more than 70 million tonnes nowadays.

From the year 2020 however, an unexpected COVID-19 pandemic occurred and had a significant impact on the palm oil industry. For example, a severe labour shortage occurred in Malaysian palm oil industry, due to COVID-19 quarantine policy that induced border closure leading to the inability to hire foreign harvesters. This labour shortage has led to a decrease in palm oil production in Malaysia (Mei Mei Chu, 2022). According to Malaysian Palm Oil Board (MPOB, 2023), Malaysian palm oil production peaked in the year 2019 with 19 858 367 t but declined to 18 116 354 t in 2021. It recovered to 18 453 420 t in 2022, but this number is still lower than the production in 2019. Furthermore, the oil palm planted area in Malaysia declined from 5 900 157 ha in 2019 to 5 674 742 ha in 2022 or a reduction of 3.8%. These factors made the growth rate of the world's palm oil production after 2020 stagnant.

Minchul Suh (2020), hereinafter *P.F,* forecasted that in the year 2020-2025, the growth rate of the world palm oil production will be stagnant and the production can even decline, after the peak seen in 2021. The reasons for this forecast were restricted expansion of oil palm plantations, lower productivity due to old age profiles of oil palm plantations, and the upcoming replanting period in Malaysia and Indonesia. The forecasted world palm oil production using the methodology by *P.F* almost coincided with the actual data in the year 2020-2022, while individual forecast for Malaysia and Indonesia did not.

The purpose of this paper is to review the *P.F* and its assumptions. By reviewing and comparing the inferred production derived from the assumptions in *P.F* with actual data, this article aims to refine the major assumptions for a more reliable forecast. This article will attempt to offer a forecast of the world's palm oil production until the year 2025.

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## METHODOLOGY

The methodology adopted in this article to infer palm oil production is basically the same as conducted in *P.F*. However, when this article infers and forecasts the palm oil production, some assumptions used in *P.F* will be changed in accordance with the actual data released.

This article and *P.F* infer the palm oil production based on the planted area, matured area and the yield profile of oil palm. In order to eliminate biases due to different source of databases from Malaysia and Indonesia, this article only uses data from the U.S. Department of Agriculture (USDA). In the USDA reports (Rahmanulloh, 2022; Wahab, 2022), we can obtain data on 'Harvested Area of Oil Palm', which is the matured area, on a yearly basis.

Assuming that the planted area of oil palm is 1000 ha in the year 2000 and becomes 1200 ha in the year 2001, it clearly indicated that there were 200 ha of newly planted oil palm area in the year 2001. Therefore, in the year 2023, we can infer that there are 200 ha of 22-year-old oil palm, which were planted in the year 2001. Based on this methodology, *P.F* inferred the age profiles of oil palm in Malaysia and Indonesia in the year 2016-2018 as *Table 1*.

After inferring the age profiles of oil palm (*Table 1)*, we can infer the oil palm Fresh Fruit Bunch (FFB) production by multiplying *Table 1* with the yield profile in *Table 2*. Using *Table 1* and *Table 2*, we can infer that in the year 2018, 3 year old oil palm trees planted in Malaysia produced around 1 440 000 t (180 000 ha × 8.0 t/ha) of FFB, assuming it was in a medium condition.

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

| Age / Yr | 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** |
| **Matured Area** | **4 900** | **5 200** | **5 300** | **10 600** | **11 000** | **11 300** |

Note: USDA provides seasonal data for October-September. This article adopts the beginning year when using matured area (area harvested) data and adopts the ending year when using production data. The planted area of 0-2 year old (immature) oil palms is excluded from the matured area (area harvested) because immature oil palms are unable to yield palm oil.

**TABLE 2. YIELD PROFILE OF OIL PALM**

| Age of Oil 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).

*P.F* used the methodology above to forecast the future production of palm oil. Before forecasting, we can infer the past production of palm oil using this methodology and the assumptions. We can check whether this methodology is valid, by comparing this inferred past production with the actual past production data. After this verification, we can infer the future production of FFB and palm oil.

## RESULTS AND DISCUSSION

### Review of the Previous Forecast

Using the methodology stated in this article, *P.F* forecasted that the world palm production growth will be stagnant from 2019 and the production can decrease after 2021. This is shown in *Figure 1*, with the forecasted palm oil production (dashed lines) and the actual palm oil production (solid line). The forecasted period of *P.F* is shown as a red dotted box in *Figure 1*. As shown in *Figure 1*, the forecasted world palm oil production in *P.F* almost coincided with the actual data released, but the forecasted production for Malaysia and Indonesia deviated from the actual data.

In *P.F*, several assumptions were adopted in order to infer and forecast the palm oil production, which are displayed as dashed lines in *Figure 1*. Firstly, *P.F* assumed that the productivity, or the yield of oil palm FFB, of 25 year old is maintained until 29 year old. Secondly, *P.F* assumed that the oil extraction rate (OER) of palm oil is 23.0% in Malaysia and 20.0% in Indonesia. Lastly, *P.F* assumed that Malaysian FFB productivity is 85.0% of the medium condition of yield profile in *Table 2*, while Indonesia is 75.0%. With the assumptions above, the inferred palm oil production derived from methodology in *P.F* showed a high correlation, which is 99.8%, with the actual data released in the year 2001-2018.

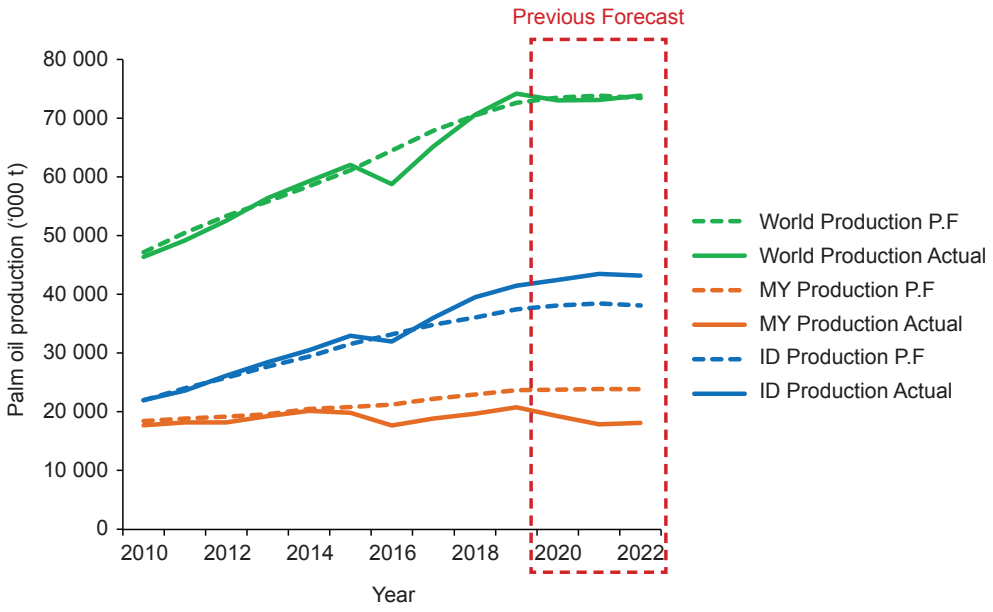


*Figure 1. World, Malaysia (MY) and Indonesia (ID) forecasted production from the previous forecast and actual data.*

Based on this result, or a high correlation with the actual released data, *P.F* regarded the methodology as valid and forecasted the future palm oil production. But for the forecast, some assumptions were added. The most important assumption added was that the future planted area in Malaysia and Indonesia will be the same as in the year 2020, because the governments of Malaysia (Ayisy Yusof, 2019) and Indonesia (Wiko Saputra and Ichsan Saif, 2018) were restricting the expansion of oil palm plantations at that time. Other than this assumption, *P.F* assumed that palm oil production from countries other than Malaysia and Indonesia accounts for 15.5% of world palm oil production, based on data in 2015-2019. In this methodology, weather factors such as El Nino, were excluded.

With all these assumptions and methodology, *P.F* forecasted the world palm oil production in the year 2020-2022 which almost coincided with the actual data released by USDA. However, the forecasts of palm oil production for Malaysia and Indonesia using the same methodology and assumptions in *P.F* deviated from the actual data, as shown in *Figure 1*.

One of the reasons why Malaysian and Indonesian forecasts deviated is because the major assumption of the forecast, that the planted area will not be changed, turned out to be wrong. According to the USDA report (Rahmanulloh, 2022), the area harvested (matured area) of oil palm in Indonesia increased from 11 750 000 ha in 2019 to 12 300 000 ha in 2021. Even though the Indonesian government announced a moratorium on expanding the oil palm plantations (Wiko Saputra and Ichsan Saif, 2018), the planted area of oil palm in Indonesia increased during this period. Other than new planting, it could also be due to less replanting than expected. Because of this unexpected expansion or less replanting of oil palm in Indonesia, the actual production of palm oil in Indonesia exceeded the forecast in *P.F*, as shown in *Figure 1*.

On the contrary, the planted area in Malaysia decreased in the year 2019-2022. According to the Malaysian Palm Oil Board data (MPOB, 2023), the planted area of oil palm in Malaysia was 5 900 157 ha in 2019, but it gradually went down to 5 675 742 ha in 2022. The Malaysian oil palm industry also experienced a severe labour shortage (Mei Mei Chu, 2022), which led to low harvesting of oil palm FFB. Because of these factors, the actual palm oil production in Malaysia was lower than the forecast in *P.F*, as shown in *Figure 1*.

However, the suggestions from *P.F* that the oil palm plantations in Malaysia and Indonesia are losing their productivity and need replanting in the near term, are still valid. According to USDA data (USDA, 2023), the productivity of palm oil (t/ha), which is calculated by dividing the palm oil production by matured area, decreased in 2019-2022. The productivity of palm oil in Malaysia was 3.9 t/ha in 2019 and fell to 3.3 t/ha in 2022. During the same period, the productivity of palm oil in Indonesia decreased from 3.7 t/ha to 3.5 t/ha, and the world's palm oil productivity decreased from 3.2 t/ha to 2.9 t/ha. This decreasing productivity indicates that the age profile of oil palm is getting older in the world, Malaysia and Indonesia thus, more plantations will need replanting in the near future in order to maintain the current palm oil production.

**Updated Inferred Production**

To update the findings from *P.F*, this article inferred the palm oil production by reflecting the actual planted area for 2020-2022 as shown in *Figure 2*, using the major assumptions from *P.F*.

However, this newly inferred production included another assumption *i.e.* the OER of palm oil. In *P.F.*, it was assumed that the OER of palm oil in Malaysia was 23.0%. In this newly inferred production, the OER in Malaysia was 23.0% before the year 2017 and 19.5% from the year 2017. According to the report overview of the Malaysian oil palm industry (MPOB, 2017), this OER downtrend from the year 2017 can be explained by lower quality FFB processed by the mills. On the contrary, the assumed OER of palm oil in Indonesia was 20.0% in *P.F*. After the update, the OER in Indonesia was 20.0% before 2017 and 22.0% from 2017. This upward trend can be explained by the improvement in agricultural practices or better seedlings of oil palm plantations were planted in the 2010's. With the OER assumption above, this methodology can better explain the past world, Malaysia and Indonesia data. However, as mentioned in *P.F*, OER is not a critical factor in forecasting the direction of palm oil production (whether it will increase or decrease).

Other than this, the assumption that palm oil production from countries other than Malaysia and Indonesia accounts for 15.5% of world production is changed to 16.1%, as reflected in the latest data for the year 2018-2022 published by USDA.

The inferred age profiles of oil palm in Malaysia and Indonesia, which are the back data of this inferred production are shown in *Table 3* and *Table 4*. Considering the small deviation between the newly inferred and actual data in 2010-2022 (*Figure 2)*, this newly inferred production also coincides with the actual data. The correlation between the newly inferred production and the actual production of the world palm oil in 2010-2022 is 98.9% (excluding the data for 2016 when there was El Nino).

**TABLE 3. INFERRED AGE PROFILE OF OIL PALM IN MALAYSIA IN THE YEAR 2016-2022 ('000 HA)**

| Age | Malaysia | | | | | | |
|---|---|---|---|---|---|---|---|
| | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| 0 | 114 | 181 | 173 | 149 | 99 | 110 | 160 |
| 1 | 180 | 114 | 181 | 173 | 149 | 99 | 110 |
| 2 | 374 | 180 | 114 | 181 | 173 | 149 | 99 |
| 3 | 241 | 374 | 180 | 114 | 181 | 173 | 149 |
| 4 | 269 | 241 | 374 | 180 | 114 | 181 | 173 |
| 5 | 175 | 269 | 241 | 374 | 180 | 114 | 181 |
| 6 | 333 | 175 | 269 | 241 | 374 | 180 | 114 |
| 7 | 200 | 333 | 175 | 269 | 241 | 374 | 180 |
| 8 | 141 | 200 | 333 | 175 | 269 | 241 | 374 |
| 9 | 248 | 141 | 200 | 333 | 175 | 269 | 241 |
| 10 | 201 | 248 | 141 | 200 | 333 | 175 | 269 |
| 11 | 223 | 201 | 248 | 141 | 200 | 333 | 175 |
| 12 | 168 | 223 | 201 | 248 | 141 | 200 | 333 |
| 13 | 139 | 168 | 223 | 201 | 248 | 141 | 200 |
| 14 | 262 | 139 | 168 | 223 | 201 | 248 | 141 |
| 15 | 215 | 262 | 139 | 168 | 223 | 201 | 248 |
| 16 | 183 | 215 | 262 | 139 | 168 | 223 | 201 |
| 17 | 569 | 183 | 215 | 262 | 139 | 168 | 223 |
| 18 | 63 | 569 | 183 | 215 | 262 | 139 | 168 |
| 19 | 85 | 63 | 569 | 183 | 215 | 262 | 139 |
| 20 | 219 | 85 | 63 | 569 | 183 | 215 | 262 |
| 21 | 125 | 219 | 85 | 63 | 569 | 183 | 215 |
| 22 | 160 | 125 | 219 | 85 | 63 | 569 | 183 |
| 23 | 110 | 160 | 125 | 219 | 85 | 63 | 569 |
| 24 | 99 | 110 | 160 | 125 | 219 | 85 | 63 |
| 25 | 123 | 99 | 110 | 160 | 125 | 219 | 85 |
| 26 | 131 | 123 | 99 | 110 | 160 | 125 | 219 |
| 27 | 64 | 131 | 123 | 99 | 110 | 160 | 125 |
| 28 | 80 | 64 | 131 | 123 | 99 | 110 | 160 |
| 29 | 74 | 80 | 64 | 131 | 123 | 99 | 110 |
| **Planted Area** | **5 568** | **5 675** | **5 768** | **5 853** | **5 821** | **5 808** | **5 869** |
| **Matured Area** | **4 900** | **5 200** | **5 300** | **5 350** | **5 400** | **5 450** | **5 500** |
| **Rate of old plantations (Age > 20)** | **19.7%** | **21.4%** | **21.1%** | **20.8%** | **28.8%** | **29.6%** | **31.4%** |

**TABLE 4. INFERRED AGE PROFILE OF OIL PALM IN INDONESIA IN THE YEAR 2016-2022 ('000 HA)**

| Age | Indonesia | | | | | | |
|---|---|---|---|---|---|---|---|
| | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
| 0 | 496 | 324 | 495 | 438 | 238 | 445 | 285 |
| 1 | 403 | 496 | 324 | 495 | 438 | 238 | 445 |
| 2 | 499 | 403 | 496 | 324 | 495 | 438 | 238 |
| 3 | 485 | 499 | 403 | 496 | 324 | 495 | 438 |
| 4 | 730 | 485 | 499 | 403 | 496 | 324 | 495 |
| 5 | 678 | 730 | 485 | 499 | 403 | 496 | 324 |
| 6 | 576 | 678 | 730 | 485 | 499 | 403 | 496 |
| 7 | 391 | 576 | 678 | 730 | 485 | 499 | 403 |
| 8 | 861 | 391 | 576 | 678 | 730 | 485 | 499 |
| 9 | 799 | 861 | 391 | 576 | 678 | 730 | 485 |
| 10 | 450 | 799 | 861 | 391 | 576 | 678 | 730 |
| 11 | 487 | 450 | 799 | 861 | 391 | 576 | 678 |
| 12 | 376 | 487 | 450 | 799 | 861 | 391 | 576 |

**TABLE 4. INFERRED AGE PROFILE OF OIL PALM IN INDONESIA IN THE YEAR 2016-2022 ('000 HA) (continued)**

| Age | Indonesia | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| 13 | 354 | 376 | 487 | 450 | 799 | 861 | 391 |
| 14 | 523 | 354 | 376 | 487 | 450 | 799 | 861 |
| 15 | 487 | 523 | 354 | 376 | 487 | 450 | 799 |
| 16 | 517 | 487 | 523 | 354 | 376 | 487 | 450 |
| 17 | 122 | 517 | 487 | 523 | 354 | 376 | 487 |
| 18 | 371 | 122 | 517 | 487 | 523 | 354 | 376 |
| 19 | 448 | 371 | 122 | 517 | 487 | 523 | 354 |
| 20 | 121 | 448 | 371 | 122 | 517 | 487 | 523 |
| 21 | 339 | 121 | 448 | 371 | 122 | 517 | 487 |
| 22 | 285 | 339 | 121 | 448 | 371 | 122 | 517 |
| 23 | 445 | 285 | 339 | 121 | 448 | 371 | 122 |
| 24 | 238 | 445 | 285 | 339 | 121 | 448 | 371 |
| 25 | 145 | 238 | 445 | 285 | 339 | 121 | 448 |
| 26 | 124 | 145 | 238 | 445 | 285 | 339 | 121 |
| 27 | 46 | 124 | 145 | 238 | 445 | 285 | 339 |
| 28 | 103 | 46 | 124 | 145 | 238 | 445 | 285 |
| 29 | 99 | 103 | 46 | 124 | 145 | 238 | 445 |
| **Planted Area** | **11 998** | **12 223** | **12 615** | **13 007** | **13 121** | **13 421** | **13 468** |
| **Matured Area** | **10 600** | **11 000** | **11 300** | **11 750** | **11 950** | **12 300** | **12 500** |
| **Rate of old plantations (Age > 20)** | **17.2%** | **16.8%** | **19.4%** | **21.4%** | **21.0%** | **23.5%** | **25.1%** |

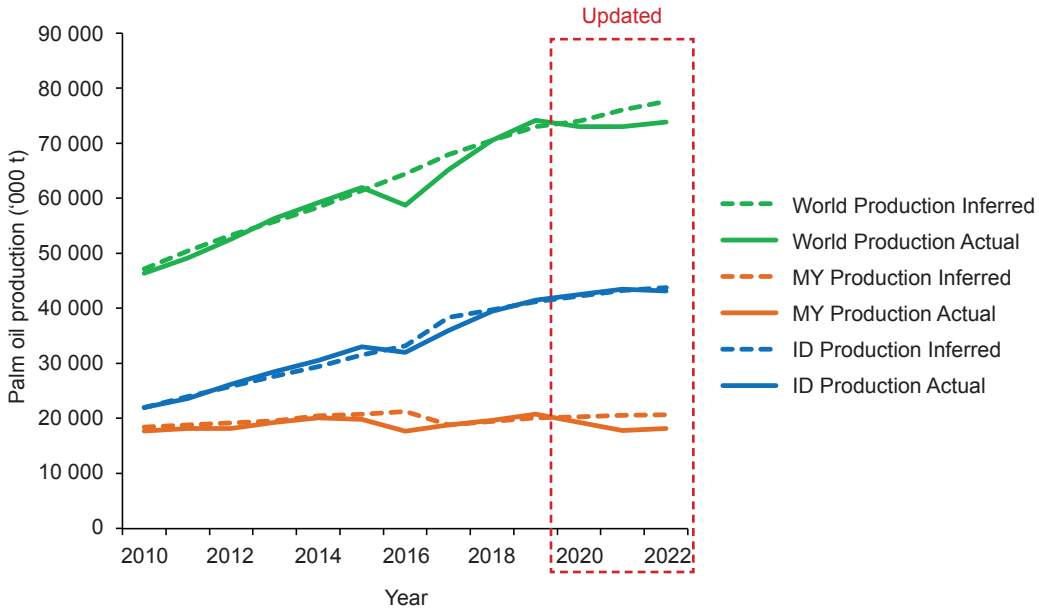


*Figure 2. World, Malaysia (MY) and Indonesia (ID) newly inferred production and actual data.*

Looking at the production in 2020-2022, the newly inferred production is bigger than the actual data for both the world and Malaysia. This phenomenon can be explained by the labour shortage in Malaysia because the methodology used in this article does not cover the labour factor.

The growth of palm oil production was stagnant in 2020-2022 (*Figure 2*), while the planted area and matured area both grew in this period according to USDA data. The main reason for this stagnant growth is that the number of old plantations (aged more than 20 years old) is getting higher. As the oil palm plantations are getting older, the oil yield decreases and it leads to stagnant growth of palm oil production, despite the expansion of the planted area.

**Updated Forecast**

In *P.F.*, after verifying the methodology with the correlation between the inferred and actual data (which was 99.8%), future palm oil production was forecasted, with a major assumption added. This major assumption was that the planted areas in Malaysia and Indonesia would not be changed. However, we cannot use this assumption anymore, as the moratorium on oil palm plantations was terminated by the Indonesian government (Bernadette, 2021) and in Malaysia, the oil palm planted area is declining. Without this assumption, it is not possible to forecast how much area will be newly planted in the future.

According to the yield profile of oil palm (*Table 2)*, oil palm trees that are younger than 3 years old cannot yield oil palm FFB. It means that the oil palm planted in the year 2023 does not contribute to the production before the year 2026 when it becomes 3 years old. Therefore, although we cannot forecast how much area will be planted in 2023-2025, we can forecast the matured area, which is older than 3 years and producing oil palm FFB until 2025. The inferred future age profile until 2025 of oil palm plantations in Malaysia and Indonesia is shown in *Table 5*.

According to *Table 5*, the matured area both in Malaysia and Indonesia will be stagnant, but the rate of old plantations will go up until the year 2025. A high rate of old plantations will lead to low productivity. Based on this information, future palm oil production can be inferred in *Figure 3*.

**TABLE 5. INFERRED AGE PROFILE OF OIL PALM IN THE YEAR 2023-2025 ('000 HA)**

| Age | Malaysia | | | Indonesia | | |
|---|---|---|---|---|---|---|
| | 2023(E) | 2024(E) | 2025(E) | 2023(E) | 2024(E) | 2025(E) |
| - | unknown | unknown | unknown | unknown | unknown | unknown |
| 1 | 160 | unknown | unknown | 285 | unknown | unknown |
| 2 | 110 | 160 | unknown | 445 | 285 | unknown |
| 3 | 99 | 110 | 160 | 238 | 445 | 285 |
| 4 | 149 | 99 | 110 | 438 | 238 | 445 |
| 5 | 173 | 149 | 99 | 495 | 438 | 238 |
| 6 | 181 | 173 | 149 | 324 | 495 | 438 |
| 7 | 114 | 181 | 173 | 496 | 324 | 495 |
| 8 | 180 | 114 | 181 | 403 | 496 | 324 |
| 9 | 374 | 180 | 114 | 499 | 403 | 496 |
| 10 | 241 | 374 | 180 | 485 | 499 | 403 |
| 11 | 269 | 241 | 374 | 730 | 485 | 499 |
| 12 | 175 | 269 | 241 | 678 | 730 | 485 |
| 13 | 333 | 175 | 269 | 576 | 678 | 730 |
| 14 | 200 | 333 | 175 | 391 | 576 | 678 |
| 15 | 141 | 200 | 333 | 861 | 391 | 576 |
| 16 | 248 | 141 | 200 | 799 | 861 | 391 |
| 17 | 201 | 248 | 141 | 450 | 799 | 861 |
| 18 | 223 | 201 | 248 | 487 | 450 | 799 |
| 19 | 168 | 223 | 201 | 376 | 487 | 450 |
| 20 | 139 | 168 | 223 | 354 | 376 | 487 |
| 21 | 262 | 139 | 168 | 523 | 354 | 376 |
| 22 | 215 | 262 | 139 | 487 | 523 | 354 |
| 23 | 183 | 215 | 262 | 517 | 487 | 523 |
| 24 | 569 | 183 | 215 | 122 | 517 | 487 |
| 25 | 63 | 569 | 183 | 371 | 122 | 517 |
| 26 | 85 | 63 | 569 | 448 | 371 | 122 |
| 27 | 219 | 85 | 63 | 121 | 448 | 371 |
| 28 | 125 | 219 | 85 | 339 | 121 | 448 |
| 29 | 160 | 125 | 219 | 285 | 339 | 121 |
| **Planted Area** | **unknown** | **unknown** | **unknown** | **unknown** | **unknown** | **unknown** |
| **Matured Area** | **5 489** | **5 439** | **5 474** | **12 293** | **12 453** | **12 399** |
| **Rate of old plantations (Age > 20)** | **34.3%** | **34.2%** | **34.8%** | **26.1%** | **26.4%** | **26.8%** |

Note: (E) – Estimated.

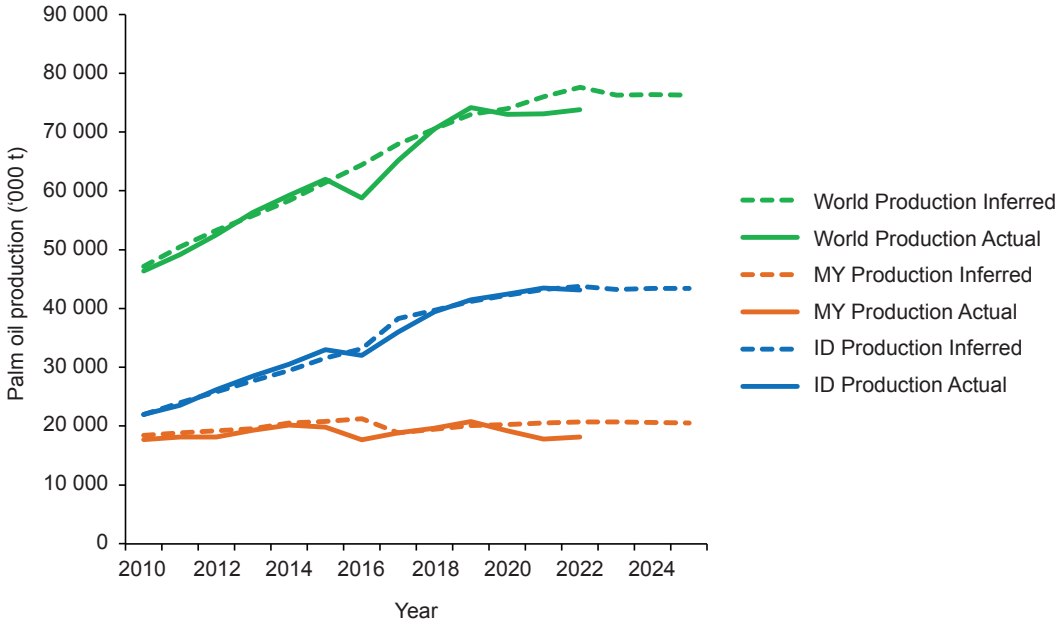


*Figure 3. World, Malaysia (MY) and Indonesia (ID) newly inferred, forecasted production and actual data ('000 t).*

## CONCLUSION

According to the methodology and assumptions in this article, the growth rate of palm oil production will be stagnant until the year 2025. According to a report by the United Nations (UN, 2022), the world population will continue to grow to 8.5 billion by the year 2030 and per capita consumption of vegetable oil will also increase (OECD/FAO, 2022). *P.F* forecasted that these factors would cause palm oil shortage, and the market price of palm oil rose from RM2274/t in 2018-2019 to RM3824/t (average Jan-May 2023). According to this article, as the world's palm oil production in the near future cannot grow as fast as before 2019, this shortage and a bullish palm oil market can remain until 2025.

This article stated that it is not possible to predict newly planted areas in the future. However, more strict environmental regulations and voluntary efforts to conserve the environment (Philip Yap *et. al.*, 2021) can make the expansion of new oil palm plantations in Malaysia and Indonesia difficult.

The methodology used in this article adopted USDA data in order to minimise potential biases arising from various sources in Malaysia and Indonesia. However, the oil palm matured area in Malaysia for the year 2022 is 5 127 290 ha (MPOB, 2023), which is smaller than 5 500 000 ha as recorded by USDA (2023). If the data from MPOB proves to be more reliable than the data from USDA, it is possible that future production in Malaysia could be lower than what has been forecasted in this article.

Under the circumstance that this structural declining production is expected, consumption growth due to biodiesel policy or lower production due to unexpected weather factors can accelerate the palm oil shortage. We can consider using biotechnology to improve OER, which has the potential to increase palm oil production. However, it will take time for these factors to affect oil palm production growth as it takes 3 years for a newly planted oil palm to produce FFB.

The palm oil market in *P.F.* was predicted to shift from bearish to bullish within 2 to 3 years due to a decrease in production. Currently, the market has indeed become bullish. Based on the forecast in this article, this trend is expected to continue until 2025, as palm oil production remains stagnant.

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