Low ILUC-risk certification: Pilot report and recommendations

Colombia, Oil palm yield increase, August 2022

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1. Pilot introduction

This pilot was conducted to test the low ILUC-risk certification methodology for oil palm yield increase measures, as defined in Implementing Regulation (EU) 2022/996 on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria.

1.1 Recap Phase 1 Pilot

The phase 1 pilot in Colombia looked at the installation of an irrigation system in a large (3,000 ha) plantation. Our main observation from the phase 1 pilot is that the implementation of mature additionality measures, like a new irrigation system, are likely to fail the financial attractiveness additionality test, as they are often well-designed and planned projects undertaken only because they are economically feasible. Unless and until a price premium for low ILUC-risk biofuels develops, and this premium is passed on to feedstock producers, this is likely to continue.

For this reason, for the phase 2 pilot in Colombia, we focused on elaboration of the alternative additionality test option, namely the barrier analysis. Specifically, the phase 2 pilot focused on how to define a “first-of-a-kind” measure. The measure studied was the application of a hormone in the flowering stage of hybrid oil palm trees, to increase oil yields.

Phase 2 of the Colombian pilot therefore offers the opportunity to test an innovative measure that could transform the productivity of the oil palm sector in Colombia.

1.2 Feedstock and Geography

This pilot was conducted to test the low ILUC-risk certification methodology for **yield increase of oil palm** on the Palmasol plantation in Colombia, and of the **oil yield increase of the fruit** produced by Palmasol, at the EntrePalma mill.

- Location: San Martin, Los Llanos, Meta, Colombia (Figure 1)

  Los llanos is a grassland area located between the Oriental mountain range and the Orinoco river. The area has been used historically for low density grazing. In the last 50 years, some areas have been converted to oil palm

- Size: Palmasol has 528 ha of hybrid oil palm

- Ownership: Palmasol is a private company, which started operating in 1992

- The plantation is certified to ISCC

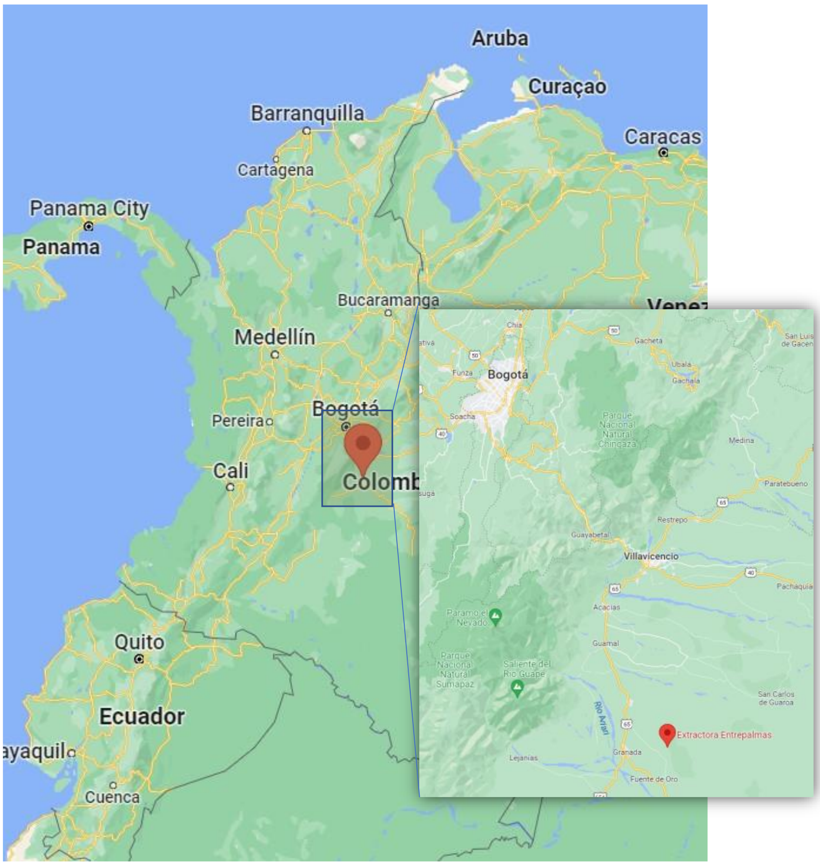

Figure 1. Location of the plantation (Source: Google Maps)

1.3 Audit

A pilot audit was conducted on-site by ISCC-trained Control Union auditor Ignacio Falcone on **1-3 August 2022**. The lead auditor was accompanied during the audit by Roberto Rodriguez Labastida from Guidehouse. On 1 August, the audit included data collection from Palmasol (the plantation), interviews with the operations team, and a visit to the fields. On 2 August, the audit included data collection from EntrePalmas (the mill), interviews with the operations team, and a visit to the mill. Finally, on 3 August, the audit concluded with interviews with the management team of Palmasol and EntrePalmas.

1.4 Key issues tested

The key issues that the pilot aims to test are:

- **Data availability.** To test whether sufficient historical yield data is available and the degree of granularity (e.g. plot, block, whole plantation, mill)
- **Non-financial barrier analysis.** To test the approach to recognise a first of-a-kind measure, define limitations to claiming the measure, and demonstrate the experience of non-financial barriers.
- **Determining the dynamic yield baseline for perennial crops (oil palm).**

- **Calculation of additional biomass.** To test the approach to calculate additional biomass.
- **Sustainability of additionality measure.** To test that the additionality measure is conducted in a "sustainable manner", as required by the Delegated Regulation (EU) 2019/807.

1.5 Relevant documents

During the audit, the following documents were collected including:

- Management plan (filled in by the economic operator)
- Dynamic yield baseline and additional biomass calculation (both in fresh fruit bunches and in oil)
- Audit checklist (prepared by Control Union)
- Audit report (prepared by Control Union)

2. Additionality Measure

The additionality measure tested is the use of a plant growth regulator hormone – Naphthalene Acetic Acid (NAA, or ANA in Spanish), as a replacement to artificial pollination of hybrid oil palms.

The introduction of hybrid oil palms

Hybrid oil palms were introduced in Colombia to replace African oil palms affected by terminal diseases. The use of NAA has two effects on the yield. It can increase the weight of the fresh fruit bunches (FFB), and it can increase the oil content of each FFB. One potentially negative effect of using NAA is the loss of the palm kernel. This pilot therefore aims to understand and measure the impact of NAA on the **total oil yield** (crude palm oil plus palm kernel oil) as palm kernel oil is a valuable co-product from oil palm production.

Palmasol began transitioning its old African palm trees (teresis) to hybrid American and African oil palms with seeds sourced locally from La Cañada seed producers. The hybrid palm development happened in the 1980s from works done by Indupalma and Cidat, but the hybrid was not used commercially until the 2000s, when the African palms in Colombia and especially in the Meta region, became affected by two diseases: Bud rot (Pudricion de Cogoyo) and Lethal Wilt (Marchitez Letal), which lower the yield and ultimately kill African palm (Figure 2).

Local scientists noticed that the hybrids were not affected by these diseases. Oil palm growers, in an aim to save their plantations and previous investment in mill capacity (to avoid having to close mills without sufficient oil yield), started to plant the hybrid oil palms. Palmasol's first hybrids were introduced experimentally in 2006, but it wasn't until 2010, when their plantation was affected by the diseases that they had to scale up significantly.

At the end of 2021, Palmasol has 528 ha of hybrid palm out of a total of 2,641 ha oil palm, with ages of the hybrid trees varying from 4 to 11 years.

Figure 2 Example of African Palm field Affected by Bud rot and Lethal Wilt

An additional benefit from planting hybrids, is that the hybrid palm grows at a lower speed compared to the African palm (15-25 cm per year for the hybrid, compared to 30-50 cm for the African). This is expected to increase the longevity of the plantations (i.e. the time before the trees need to be replanted) to up to 40 years, compared to 25 years for the African variety. The main constraint with aging oil palm trees is the difficulty to harvest fruit from very tall trees, which becomes more complex and dangerous and requires skilled and relatively more expensive labour (also more fruit is lost when FFB drop from a great height).

While hybrids are disease-resistant, their growth requires an additional process. Hybrid palms need to be pollinised manually with African palm pollen due to the infertility of the hybrid pollen. The manual pollination needs to be done within 24hrs of flowering (Atesis) to be able to produce a viable fruit. This process is labour-intensive as it requires crews of pollinators working every day of the year to ensure flowering is not missed. The potential for fresh fruit bunch production is not reached due to missing the pollination window. For example, if there is a storm, strike or holiday, farmers would miss the right time of flowering and therefore no pollination occurs. The manual pollination needs to be done to every flowering bunch for three consecutive days to achieve maximum results.

Figure 3 Three year-old hybrid palms

The discovery of NAA

The Colombian research group, Cinepalma, developed an alternative process to artificial pollination. The process uses a plant growth regulator, called Naphthalene Acetic Acid. Cinepalma tested several plant regulating hormones, discovering that NAA offered the best results. The product was designed to replace the use of manual pollination for hybrid palms, which is so sensitive to the timing of application. Instead, the application of NAA can be done within three weeks of flowering without any impact in fruit production.

On top of higher levels of successful pollination that can be achieved, the unexpected benefit of using NAA was an increase in oil production from 18% to 35% of oil content in the FFB.

The implementation of NAA is relatively easy as it doesn't need special storage, require any special training, and is applied in the same way as regular pollen.

In theory, the NAA could be applied all over the world, wherever hybrid palms are used. However, it has only been three years since the first implementation and the intensification phase just started. Oil palm growers in Ecuador have started experimenting with NAA.

Implementation of NAA at Palmsol

Palmasol started using NAA in September 2018 in one test site and rolled it out to their whole hybrid area over the next six months. Palmasol has seen increases of around 20% in FFB weight due to NAA application, with an even higher yield of crude palm oil (CPO).

Palmsol explained that the main advantage of NAA over pollen, is that it extends the application windows from 24 hours to up to three weeks. It also extends the application days to 4, so the same person can cover larger areas, reducing the labour needed for the task. In addition, the shorter height of the hybrid palms helps in the harvest.

The palm kernel is lost when switching from pollen to NAA. The kernel not only has an economic value (palm kernel oil), but the presence of the hard kernel also helps during the oil extraction process in the mill.

To overcome the issue in the mill, some growers alternate between NAA and pollen in the three applications (the options Palmsol are testing are "NAA, Pollen and NAA", "Pollen, NAA and NAA", or "NAA, NAA, Pollen"). This generates a kernel, albeit of lower quality than the normal kernel, and reduces the oil percentage in the bunches. This kernel cannot be sold to the market but it helps during the oil extraction process.

In July 2022, Palmasol decided to use NAA only, to maximise oil yield. This was enabled by EntrePalmas recent investment in a pre-conditioner process between the fruit cooking process and the extraction process. The conditioner equipment was installed two weeks before the visit, and therefore they do not have enough data to quantify the impact it will have on their oil extraction yields.

Figure 4 Application of NAA in flowering Palm Bunch

3. Findings

3.1 Availability of data and evidence

Palmasol and EntrePalmas are a medium-sized local enterprise that has invested in information systems to track their own operations. They are ISCC-certified and have performed other sustainability audits in the past. Fresh fruit bunch (FFB) yield data is collected at a granular level on a plot-by-plot basis, however this data was not available during this pilot. FFB yield data could be obtained as far back as 2010 at plot level. Data for oil yield was also available from EntrePalmas (the mill), but in this case, the data is only split between African palms and hybrid palms, and not on a more granular plot-by-plot basis, so at the mill level, it was not possible to link the oil yield back to the specific (sub-)plots but it was possible to determine the oil that came from the hybrid oil palms.

Data for the financial attractiveness assessment was partially available, including labour costs, material costs, and other costs, but the company does not track research and development (R&D) investments, which are a more significant investment cost over time than the actual cost of application of NAA.

3.2 Financial attractiveness assessment

The formal financial attractiveness assessment was not performed in detail as the NAA application costs are known to be lower than the cost of artificial pollination. Therefore, simply comparing the costs and benefits of NAA at the plantation level (especially without including R&D investments from Cinepalma, the plantation and the mill), the measure would not pass the financial attractiveness test.

Palmasol does not have a specific R&D budget. For research and testing done internally, the main cost is the lower yields achieved by "failed" tests, or higher input costs if they tried something new that didn't increase yields as expected. Plantations pay Fedepalma[1] around 1.5% of their fruit revenues, which funds the operations of Fedepalma and research by sister organisation Cinepalma.

Research is conducted extensively either on their own initiative, or as part of Cinepalma's research programs. At the time of the visit, Palmasol had new hybrid varieties that Cinepalma provided to test in their fields. In these combined initiatives, Cinepalma usually provides the inputs, and the plantation provides the labour.

The economic impact from the introduction of NAA to the mill was more significant than to the plantation. EntrePalmas lost money with the introduction of NAA, as previously they earned revenues from selling the kernel to the crushers[2]. The revenue from the kernel sales is especially important for mills as their economics rely in this to make a profit. The rule of thumb for EntrePalmas is that they need 4 percentage points of the oil yield to pay for the costs of the operation and the remainder is paid to the plantation (for example for the African palm they crush, 4 percentage points of the 22% oil per tonne of FFB are used for the mill operations, and the remaining 18 percentage points are paid to the plantation). The profit was made through the revenue from the kernel sales. Now they are adapting their revenue model to take into account the loss of the kernel. The mill estimates that they need 6-7

[1] The association of Colombian palm oil producers: https://web.fedepalma.org/

[2] The issue relates to the revenue model. In the contract, the mill shares the revenue from CPO with the plantation, taking only 4% of it to pay for the mill operation costs, but the mills keep all the revenue from the kernel as a profit.

percentage points instead of 4 percentage points above the settlement rate with the fruit grower (usually set 18% oil per tonne of FFB) to operate at a similar profit without the kernel.

3.3 Non-financial barrier analysis

This pilot explored how a potential first-of-a-kind barrier could be defined in the context of the Low ILUC-risk certification guidance. In this pilot, the shift to hybrid oil palms and NAA opens several non-financial barriers.

- **Cultivation process optimisation**: While Palmasol developed their own best practices to cultivate hybrid plants before the introduction of NAA, other EntrePalmas report that some of their other suppliers do experience barriers related to the process of cultivating hybrids. One example is a supplier that experiences low yields due to their lack of knowledge of the optimal pollination process for hybrid palms before the introduction of NAA, and that has continued with the introduction of NAA. Hybrids are more challenging to grow than African palms, because the overall process required to cultivate the hybrid palms increase by several steps. Close monitoring of the hybrid palms across the plantation is required to detect flowering to identify the right time to apply pollen or NAA. This is very different to the simple "fertilize and harvest" process of cultivating African palms.

- **Availability of NAA**: Initially, availability of NAA was an issue. Cinepalma's research was conducted used using liquid NAA, but this product was only available in small quantities and was difficult to apply in the flowers. Palmasol did their own supply chain research and found a powdered version. This was easier to apply but was only produced in small batches which made it costly. Palmasol convinced the supplier to increase their supply to make it viable at scale, and worked with them and Cinepalma to get import approval from the Colombian government.

- **Mill equipment modifications**: The mill technology was originally designed in Malaysia to process African palm. Currently there is no specific technological toolset to process hybrid palms in these mills, and the situation is even more complex for mills crushing both types of oil palm. The main issue is during the pressing. The traditional mill design uses the palm nut (kernel and skin) to help to distribute the forces applied by the press around the mash. Without the kernel (as is the case when NAA is used to pollinate the hybrid palms), the pressing had a significantly lower efficiency and problems are experienced in the flow rates. EntrePalmas and other mills have been running experiments to increase efficiency. In the case of EntrePalmas, they decided to add part of the kernels from the African palm batches into the hybrid batches, which resulted in good oil yields but the (relatively valuable) kernel cracks in the process and is lost. For this reason, they introduced a conditioner unit in one of their presses to see if they can stop using kernels (Figure 5). The newly developed (with their input) conditioner step between the digester and the press was introduced in the mill at the end of July 2022 (15 days before the visit). In theory, this will allow them to extract higher oil yields without the help of mechanical additives.

Figure 5 New conditioner unit installed to process kernel-less fruit bunches

- **Impact on the oil specifications**: Another issue introduced by hybrids, is that the oil produced has a different specification compared to traditional CPO. CPO is a well-defined commodity and hybrid oil does not meet with this specification. The main issues are the iodine content, which needs to be below 55 (gI/100gr) and hybrids are usually between 65 and up to 70. Another issue is the ratio between stearic and oleic fatty acids. CPO has around 35-40% stearic fatty acids, while hybrid CPO usually has between 10-15%. This is a problem for traditional CPO buyers, like margarine producers, who rely on the stearic acid content to produce their products without trans-fats. On the other hand, biodiesel producers benefit from this higher level of stearic and oleic fatty acid level, as the oil requires less refining and the fuel produced has a significantly lower clouding point (closer to soy) which makes it better for colder climates (even within Colombia). Despite this, the lack of standard specifications for hybrid oil does not allow EntrePalmas to sell at a premium to biodiesel producers.

Figure 6 Due to the different oil characteristics, mills need to keep separate milling lines for hybrids and African palm FFB (Hybrid line shown)

3.4 Determining the dynamic yield baseline

In this pilot, we aimed to determine the dynamic yield baseline **both** using FFB weight yield **and** in addition, using total oil production, which includes both crude palm oil (CPO) and palm kernel oil (PKO) yield. The low ILUC-risk methodology suggests that the raw biomass unit should be used to determine the baseline (in this case FFB). However, as the NAA increases the CPO content of the FFB as well as the FFB weight but also decreases PKO yield, it was interesting to calculate the baseline based on total oil yield to explore how the loss of the PKO could be accounted for, and for comparison with a baseline calculated using harvested FFB weight.

The yield data included is for oil palm cultivation at Palmasol plantation, with the oil extraction done at EntrePalmas mill. The volumes used to portray historic data were the actual FFB and oil yields from the three complete years before the introduction of NAA (2016 to 2018). To demonstrate yield development, the actual yield data for the hybrid palm plots for 2019 to 2021 was collected, as well as the plantations own yield *estimations* from 2022 to 2030. The information regarding the yield was obtained based on the information from the internal system (reception FFB weight at the oil mill and oil output from hybrid palm production line) and the cultivated area data was obtained from Palmasol mill. The part of the plantation used in the analysis consists of 528 ha of **hybrid trees** planted between 2010 and 2017.

The data on the age distribution of the trees was available, but the FFB and oil yields were not available on a plot-by-plot basis. However, the data does distinguish between African palm and hybrid palm. In determining the dynamic yield baseline and additional biomass, only hybrid palm yield was considered. Table 1**Error! Reference source not found.** and

Table 2 below show the age distribution of the trees and the historic, actual and (future) expected yield for the hybrid palm trees.

Table 1 Hybrid palm age distribution

Planting year	Age in 2019	Area (ha)	% of the area
2010	9	55.18	10.44%
2012	7	77.68	14.70%
2013	6	57.39	10.86%
2014	5	214.4	40.57%
2016	3	41.27	7.81%
2017	2	82.5	15.61%
		528.42	**100.00%**

Table 2 Historic, actual and (future) expected yield in FFB and oil for hybrid palm (tonne/ha/yr)

	Year	FFB	Oil
Historic yield	**2016**	5.0	1.0
	2017	11.3	2.2
	2018	11.8	2.4
Actual yield	**2019**	14.9	3.1
	2020	19.7	4.2
	2021	22.3	5.3
Expected yield	**2022**	20.2	6.0
	2023	24.6	6.2
	2024	24.4	6.4
	2025	24.4	6.3
	2026	23.5	6.5
	2027	23.8	6.2
	2028	22.8	6.6
	2029	24.0	6.3
	2030	23.0	

Palmasol mill had data on the different ages of their trees, for all their plots, going back to the beginning of the plantation. If yield data per plot was available, then the age of the trees would be used to determine the yield curve that the trees of the same age would follow if the additionality measure would not have been taken. As this was not available, we have taken a weighted average per year of the age of the tree and the normalised yield curve presented in Implementing Regulation 2022/996 Annex VIII to create an adjusted normalised yield curve suited to the weighted average ages of hybrid palm tree per year, as presented in Table 3Table 3.

Table 3 Weighted average age of the hybrid palm trees with corresponding adjusted normalised yield curve

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Y-3	Y-2	Y-1	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11
Average age of the trees	2.3	3.2	4.2	5.2	6.2	7.2	8.2	9.2	10.2	11.2	12.2	13.2	14.2	15.2	16.2
Adjusted normalised yield curve	0.15	0.29	0.43	0.60	0.74	0.83	0.92	0.96	0.98	0.98	0.97	0.96	0.94	0.93	0.91
Annual change	-	88%	50%	40%	22%	13%	10%	5%	1%	0%	-1%	-1%	-2%	-2%	-2%

To account for the three different impacts of the additionality measure on yield – higher FFB weight, higher percentage of oil in the FFB, and the loss of the kernel – two baseline calculations were done using the weighted average adjusted normalised yield curve presented in Table 3 above.

The first calculation was done using the FFB yield (Figure **7**), and the second was done using the total oil yield – the sum of CPO and PKO (Figure 8Figure 8). The starting point of the calculation is the average yield from the hybrid palm of the three years prior to the additionality measure (Y-3 to Y-1). Then, the annual change of the normalised yield curve was applied, followed by the compound annual growth rate (CAGR) of 1.37% as per Annex VIII of Implementing Regulation 2022/996.

It is important to note that – because of the data available at the time of the pilot – the methodology used in this pilot was done on a weighted average of the hybrid palm trees and not on a plot-by-plot basis. This has the following implications:

1. In 2017, 82 ha was replanted (about 15% of the area). As the calculation starts in 2016, the age of the trees was set at 0 for the purpose of determining the baseline, which would have an impact of a lower average age of the trees and therefore a different position on the normalised yield curve.

2. The average age of the trees in the beginning year of the NAA application (2019) was 5.2 years, the youngest being 2 years and the oldest being 9 years. The youngest trees were therefore still immature and growing exponentially. In the starting year of the baseline (Y-2, or 2017) the trees had a weighted average age of 3.2 years, see Table 3. However, the starting yield of the baseline (based on the average of the three years prior to the additionality measure) was 7.9 FFB tonnes/hectare/year. The combination of newly planted trees with trees in their growing stage therefore increases the height of the dynamic yield baseline to the point where it surpasses 27 FFB tonnes/hectare/year at its peak, which is considered to be very high.

The calculations done for this pilot highlight that **a plot-by-plot baseline calculation would be more accurate and in line with the methodology set out in the Implementing Regulation** to determine the dynamic yield baseline. The approach taken here of averaging yields from different ages of trees can lead to an inaccurate baseline, especially if there is a mix of very young trees which are still subject to exponential annual yield growth. In this case, the approach over-estimated the dynamic yield baseline, but averaging yields could also lead to an under-estimated baseline. For mixed ages of trees, a plot-wise determination of dynamic yield baseline is needed.

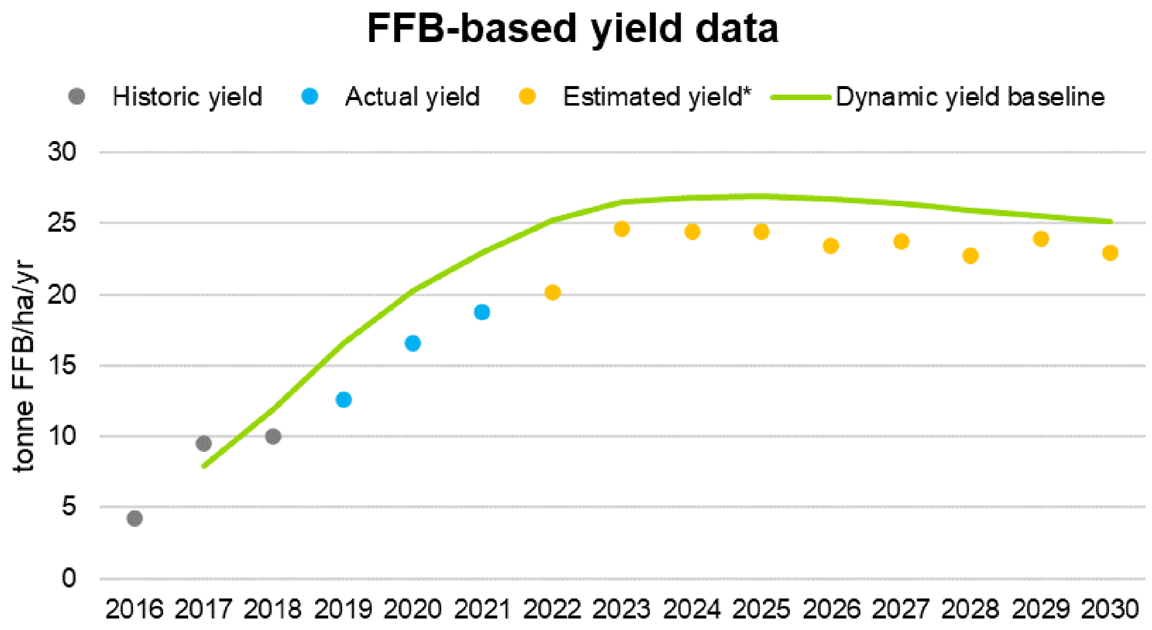

Figure 7 **Dynamic yield baseline (green line) using FFB yield of hybrid palm following implementation of NAA (blue) and forecast yield (yellow).**

** As estimated by the economic operator*

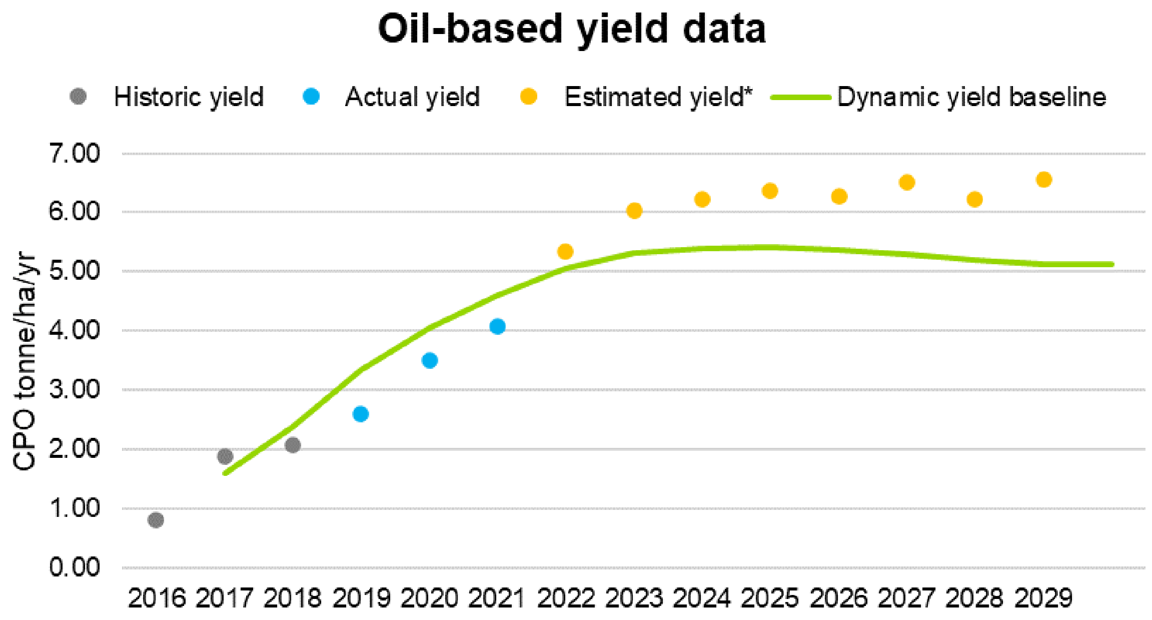

Figure 8 Dynamic yield baseline (green line) using total oil yield of hybrid palm following implementation of NAA (blue) and forecast yield (yellow)

** As estimated by the economic operator*

3.5 Calculation of additional biomass

Based on the analysis of the data obtained, the replacement of artificial pollination with NAA can have an impact on the yields, and, in this case, the impact is significantly larger when calculated in total oil yield, compared to FFB yield.

In **FFB yield**, based on these calculations and yields forecasted by the plantation, no additional biomass could be claimed in any of the years. (Note comments in the previous section that there is a high possibility that the dynamic yield baseline is over-estimated.)

In **total oil yield**, the additionality measure can be responsible for an increase in yield and subsequent additional biomass. **This includes accounting for the complete loss of the kernel, and the associated PKO produced from it.** The oil yield increase in hybrid palms obtained by replacing artificial pollination with the application of NAA is significant. In fact, the plantation owners are hopeful that they will be able to match results observed in experimental fields in which they achieved higher total oil yields compared to similarly-aged African palms in good condition.

If this is the case, it is possible that replanting of African palms will be done with hybrid palms with NAA application, even in areas not affected by disease. If other plantations follow a similar trend, the use of NAA as an additionality measure could have a positive impact in the production of CPO in the areas of South America using hybrid palms, without increasing land use.

In this case of the NAA application, setting the dynamic yield baseline based on the oil yield instead of the FFB yield would result in higher estimated additional biomass. The calculation on the basis of oil would also take any mill yield improvements into account.

3.6 Sustainability of the additionality measure

The operation (Palmasol and EntrePalmas) is currently certified to both RSPO and ISCC. These current certifications only check whether the plantation complies with the law in this respect.

4. Conclusions and recommendations for low ILUC-risk methodology

4.1 Key conclusions from this pilot

The overarching conclusions that can be drawn from this pilot are:

- **Data availability.** FFB yield data was available at the plantation and at a granular (plot-by-plot) level, but was not available during the pilot. Yield data and tree age data was recorded and kept from as far back as 2010 at a plot level. Oil yield data was available from the mill, but in this case, the data is only split between African Palm or Hybrid Palm, and not on a plot-by-plot basis. It was therefore not possible to determine oil yield per (sub)plot, but it was possible to set the baseline using total hybrid palm oil yield. Data for the financial attractiveness assessment was partially available, including labour costs, material costs, and other costs, but the company does not track R&D investments. Overall, availability of verifiable data was not a challenge in the pilot.
- **Financial attractiveness test:** the application of NAA is cheaper than the alternative artificial pollination. Therefore, this measure would not pass the financial attractiveness test, unless a credible way could be found to incorporate research and development costs in the assessment. It is difficult to quantify in an economic way the cost of this adaptation process beyond specific equipment purchases or input quantities differences, as the trials are usually done with the same labour and agronomist team, as the day-to-day operations. The real cost is the unrealised yields of the failed experiments compared to the successful ones, but this is not going to be known until "best practices" are clearly established.
- **Non-financial barrier analysis.** The focus in this pilot was to test the guidance with an example of a potential first-of-a-kind barrier. In this pilot, the shift to hybrid oil palms and NAA created several non-financial barriers due to the novelty of the technology used.

  While Palmasol has introduced NAA in all its hybrid plots and will continue planting hybrids to replace their aging fields, they have not yet achieved the oil yields obtained in Cinepalma's experimental hybrid plots. They did manage to recover their yields to levels similar to African palm, and they expect that they will surpass African palm yields over the next few years and believe there is room to continue improving.

  The introduction of NAA is just the first step of a significant learning and adjustment process. This includes developing new equipment at the plantation and mill levels and changing growing and extraction parameters to adjust to the new crop.

  In the consortium's view, the Palmasol/EntrePalmas operation would qualify as a "first-of-a-kind" measure, as they are still in an experimental phase between the innovation discovery point and the establishment of clear "best practices" that others can follow without facing the adaptation challenges. The same measure should be considered as a first-of-a-kind measure if its introduction in a plantation is done in the period between the first attempt to increase yields and the establishment of "best practices" considered. The guidance should attempt to set a practical solution to this problem.

  However, there is no clear link to suggest that the measure is taken to increase yield for biofuels or because of low ILUC-risk certification. The shift in production model is driven by the force majeure of the diseases, and the consequent research and development is driven by the survival of the business rather than a driver to produce additional biomass for a particular market.

- **Determining the dynamic yield baseline for perennial crops (e.g. Oil palm).** Setting an accurate dynamic yield baseline was challenging for this pilot as yield data was not available to the pilot team on a plot-by-plot basis and the plantation had a mixture of ages of trees, many of which were young and in the exponential part of their growth phase. The dynamic yield baseline calculation was performed using the available data in FFB and in Total oil yields (CPO + PKO). Due to the data availability, the baselines were calculated using an adjusted normalised yield curve based on the weighted average of the hybrid palm tree ages. The replanted area in 2017 posed for an additional challenge in setting the baseline, as including this area would result in a lower average age (especially in 2016 prior to the replanting) and excluding this area was not possible as the estimated yield was based on the whole area where the hybrid palm was planted. The dynamic yield baseline calculated is expected to be too high for this plantation due to the mixture of young trees. Yield data is therefore needed on a plot-by-plot level to set an accurate baseline per age of tree.

- **Calculation of additional biomass.** The additional biomass calculation was possible with the data gathered, albeit with some limitations as discussed above. There was a significant difference in the estimated additional biomass depending on whether the calculation was done based on FFB or based on total oil yields. The additional biomass obtained using FFB weight as unit was significantly less than the one obtained using total oil weight as unit. This is because, in the case of NAA application, the measure only slightly increases the FFB weight but it significantly increases the oil content within the FFB (even when accounting for the loss of the kernel and associated PKO). In other situations, the difference between doing the calculation based on raw biomass (FFB) and oil output would reflect mill efficiency.

4.2 Improvements to the certification guidance

The following aspects should be further detailed or clarified in the Low ILUC-risk certification guidance:

- Further guidance needs to be provided to define when a measure can count as being “first-of-a-kind”. This could include whether there are clear “best practices” defined that others can follow. However, this will be a difficult moment to define in practice. As an alternative, it could be an option for voluntary schemes (or the European Commission) to keep a list of new measures that could qualify in a particular country and set a deadline (e.g. 5 years from first pilot). Any economic operator who implements the measure before the deadline could qualify as implementing a “first-of-a-kind” measure.

- Clarify in the guidance that the starting point for the dynamic yield baseline for perennial crops should be the **middle year** of the (3) historical yield data points, and hence the normalized yield curve should be applied from this average yield and average year starting point. This is important in the approach to apply a standard yield curve for perennial crops to enable the correct shape of the curve to be applied according to the age of the trees when the historical yields data were recorded.

- Explicitly clarify that in the case of palm, the yield baseline (and additional biomass) can either be calculated on the basis of FFB or total oil yield. If calculated on the basis of oil yield at the mill, it must include both CPO and PKO.
- Explicitly state that the dynamic yield baseline and additional biomass should be determined on a plot-by-plot basis if, for example, a plantation has different ages of trees, the plantation area is expanded, or if additionality measures are taken in different years (which can be relevant for mixed age plantations where the measure is taken when a tree is a certain age, rather than a measure which is taken at the same time across a whole plantation).

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